POWER

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[A MESSAGE TO POWER READERS]

Employment and the Power Industry

IT IS gratifying to learn that the power industry has been able to provide such a bulwark of industrial activity during the year just ended. To maintain its output, payroll and regular personnel during the year 1930 to within a small percentage of the high level set in 1929 is a notable achievement.

For all these things the power industry is to be congratulated. The continued demand for electrical energy which made this record possible did not come by accident. It was based on careful planning and on the extension of power into new fields to take up the drop in the industrial load.

With a new year ahead, further planning is to be done. Of greatest importance toward relieving unemployment is that part of the program which deals with construction, improvement and maintenance. Although expansion programs must be limited by probable load requirements, it should be recognized that all sound construction and reconstruction, if undertaken now, gains by low costs. The nation also gains through increased demand for men and materials.

Therefore, if there are any border-line cases where a decision on new construction hangs in the balance, it is to be hoped that the emergency situation will be weighed along with the economy. This should apply especially to sound plant modernization and lines of improvement which add to efficiency without producing surplus capacity.

Particularly, the economic wisdom of doing all possible repair and maintenance work at this time is apparent to all. Stocks of existing materials are used. Work is provided and properties are improved. The President's Emergency Committee for Employment is emphasizing the value of pushing forward during this time of emergency construction projects which might ordinarily be spread over the next few years. With the Federal Government taking the lead in expediting millions of dollars worth of public construction to provide employment, states, counties and cities are rapidly pushing forward their own program of construction. Through the continued cooperation of the governmental and semi-public groups and the resourceful enterprise of constructional interests, the resultant volume of sound building projects will go a long way toward meeting the present employment emergency.

Arthur Woods

CHAIRMAN
The President's Emergency Committee for Unemployment

EDITORIALS

"Anti" Senators and the Power Commissioners

"O LIBERTY! LIBERTY! how many crimes are committed in thy name!" Although attributed to a lady about to be guillotined for an alleged political offense during the French Revolution, these words have a peculiar fitness in the Punch and Judy show recently staged by the so-called anti-power-trust Senators in Congress.

First came the unsuccessful effort of certain Senators to commit George Otis Smith, in advance of his appointment, to the discharge of the executive secretary of the Federal Power Commission, evidently because they considered him to be pro power company. Then, because the commissioners, after taking office, decided to eliminate friction by removing the avowedly anti-power solicitor and accountant as well as the secretary, the anti-power Senators, in their ire, proposed to oust the commissioners whose appointments they had confirmed but a few days before. One can almost hear Punch saying: "That's the way to do it! You bet!" with a toss of his bell-bespangled head.

But from the first, eminent legal authorities held the opinion that the Senate could not constitutionally require the President to rescind the commission of Messrs. Smith, Garsaud and Draper, legally given with the consent of the Senate.

To suppose that the Senators did not also know this is to assume them to be something less than eminent. So it appears by clear logic that the President's statement to the nation has effectively explained the whole action as an effort to symbolize him as a defender of power interests because he refused to sacrifice three outstanding public servants or allow the Senate to dictate to the Federal Power Commission the selection of its subordinate officials.

It is deplorable that such things are attempted at any time. But, just now, people are particularly entitled to feel that Senators should use their time constructively. Industry, and this includes the producers of industrial and utility power, will help by giving the President full and audible support in the present case, regardless of politics.

Fresh Water to Salt— A New Power Source

NOW THAT scientific minds are focused on the byways of power, new ideas are popping up with startling frequency. The latest, an outgrowth of Georges Claude's scheme for making power from sea heat, involves the simultaneous use of salt water and fresh water as found at the mouths of rivers emptying into the ocean. It will be recalled that Claude proposed (and tested) a power-generating method in which vapor from warm surface waters of tropic seas passes through a turbine and is condensed by cold water pumped from the depths. He thus takes advantage of the known fact that ocean water at great depths is very cold even near the equator.

In spite of Claude's actual operation of a small turbine in Cuba, the practicability of his ingenious method of tapping Neptune's heat is still much debated and probably will be until the inventor has made further demonstration on a commercial scale.

The new proposal, made by M. C. Raveau, of the Academy of Sciences in Paris, is based on the fact that a salt solution has a higher boiling point than one of fresh water at the same temperature. Utilizing this phenomenon, it is proposed to lead vapor from a body of fresh water through a turbine to a condenser where the vapor will condense by mingling with salt water. Presumably the plan would require the usual air pumps. In theory it should operate even with both bodies of water at the same temperature, although there would be

a definite gain by having the salt water at a lower temperature.

The tendency, of course, will be to look upon this plan as another scientific pipe dream. This it may prove to be —but perhaps not. The "perhaps" warrants a critical but open-minded analysis of this proposal.

Bleeder Turbines For Peak Loads

TURBINES with multiple bleeders are so common that new operating procedures with such units would seem improbable. Yet the recent paper by Messrs. Christie and Viessman before the Metropolitan Section of the A.S.M.E., and abstracted in this number of *Power,* points to some interesting possibilities in the use of such equipment for carrying peak loads.

The authors do not claim that all the schemes suggested are original. In fact, many may have already been discussed to some extent and some have been applied in modified form. However, the paper brings the various methods together, analyzes their possibilities when applied to specific cases and suggests economic limitations. A factor of particular interest is the maintenance of high station economy over the peaks when all the steam is passed through the turbine and the boilers are fed from hot water storage.

While the large storage volume required for prolonged peaks is a limiting feature, and while the plan would not be applicable to systems having large peaks or that require a large reserve capacity, the suggestions deserve careful study. Modifications of these schemes may be adaptable to many existing stations or applied to new plants. They represent a means of carrying peak-load capacity at low initial cost and good station economy, which is in line with present efforts.

Two Elevators In One Hoistway

IN THIS number of *Power* is described the first commercial installation of two elevator cars in one hoistway. While the merits of this arrangement can be settled only by experience, certain elements are apparent. In high buildings, which offer the best field for such installations, much less floor area for a given service would be required than with single elevators. Also, improvements in design give promise of keeping the cost close to that of a single elevator.

The technique of single-elevator operation is now well understood, and fairly accurate traffic estimates can be made. Until more experience has been had with multiple-elevator operation, this and some other factors must remain a matter of conjecture. The studies that have been made, however, are encouraging.

Control and safety features for multiple elevators have been worked out to where they are as safe, or safer, than for a single elevator. When elevators were manually controlled, cars sometimes failed to stop at the terminal landings and went into the pit or the overhead work. With automatic control such occurrences practically ceased. Automatic control requires that the equipment be kept in condition so that the car will land accurately at all floors, or the machine cannot be operated. Consequently, functioning of this equipment provides, to a large extent, a check on its conditions. The same elements that assured the safety of high-speed automatically controlled single elevators are present, plus other safety features, in the control of the multiple type.

The new system has passed the experimental stage. It is entering the commercial phase and provides another means of solving vertical transportation problems that are each year becoming more difficult.

Pseudo-Economics

PRESIDENT HOOVER recently stated that any project undertaken by the government to relieve unemployment should justify itself on economic grounds, and Congress is not the only body that should consider this sound advice.

A Canadian Chamber of Commerce has been reported as opposing the plan of a power company for the development of hydro-electric energy, and advocating, instead, the construction of a steam plant that would utilize local coal. The objective was additional employment to local miners and those engaged in coal transportation.

Unless the steam plant will produce power as cheaply as the projected hydro plant its construction would be an economic error. Any benefit that may be derived by decreasing temporary unemployment cannot possibly offset a permanent burden of higher power cost, which would hinder industrial recovery and growth of the community long after the present depression has passed. To keep faith with its public, the utility should disregard pseudo-economic considerations and construct that type of plant which will produce a kilowatt-hour marketable at the lowest price compatible with long-time reliable service.

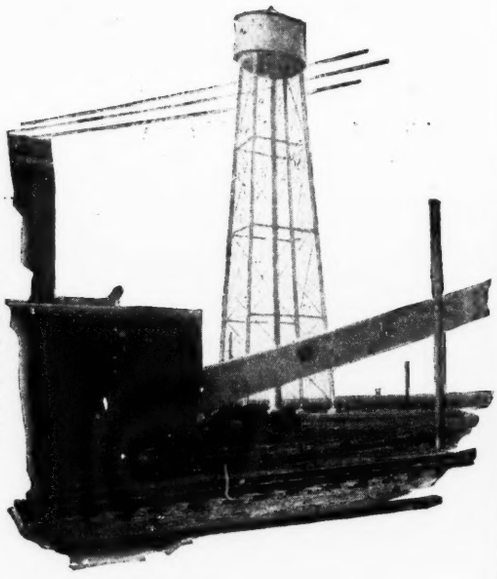
▼

POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

Raritan River Plant Combines Efficiency

TO TAKE care of the rapidly increasing power requirements of the Eastern New Jersey Power Company, a subsidiary of the Utilities Power & Light Corporation, it had become necessary to install additional generating capacity. A new site was selected on the Raritan River, just north of the Borough of Sayreville and about four miles from Raritan Bay, on the Atlantic Coast. At this location the new plant has been erected by the Management & Engineering Corporation. The initial installation is for a capacity of 60,000 kw. in two turbine-generator units, but this capacity will be increased to an ultimate of 180,000 kw. as the demand for power in eastern and central New Jersey justifies the expansion.



Simplicity and intensive use of equipment were primary factors influencing the design of the Raritan River plant, Sayreville, N. J., which has an initial capacity of 60,000 kw.

Simplicity, ease of operation, the lowest initial investment compatible with high economy, and intensive use of the equipment available were the primary factors influencing the design. For example, under existing conditions, including the size of the units and the early station load, a throttle pressure of 400 lb. figured to give the highest commercial economy. To obtain the utmost out of the investment, boiler operation up to 525 per cent nominal rating is planned.

Stokers were chosen, as their adoption tended to eliminate certain complications. Also operators of the vicinity were more familiar with their operation. With modern water and air-cooled furnaces, highly satisfactory results are anticipated.

Economizers having one-third as much surface as the boilers, and air heaters with 150 per cent of the boiler surface, reduce flue gas temperatures to 300 deg. and supply combustion air preheated to 350 deg. when operating at normal rating. The main turbines are bled at four points to heat the feed water. Owing to the high rate of operation, make-up is pretreated chemically to eliminate scale trouble. Electrically operated quick-acting safety valves on the steam manifolds conserve boiler steam, and the exchanger of a continuous blowoff system transfers the waste heat in the blowdown to the ingoing feed water.

An outstanding feature of the station is the use throughout, for auxiliary power, of the simple, reliable and inexpensive squirrel-cage motor arranged for across-the-line starting. Dual drives, duplication of units or an infinitely-variable-speed reducer provide for variation in speed where this may be necessary. Complication of motor and control equipment is obviated and reserve capacity is provided in case of a burn-out or trouble with one of the motors. This does not mean that stand-by auxiliary units are provided, but that the capacities applying to particular functions are split; loss of one set of auxiliaries or one motor of a dual drive will not cause a complete shutdown, as it is possible to carry about 60 per cent of the load with the duplicate unit. An additional advantage comes of the units being smaller than those which would be required for full-capacity operation, so that they may be worked in physically to better advantage in the station layout. The foregoing applies to the forced- and induced-draft fans and the condenser auxiliaries.

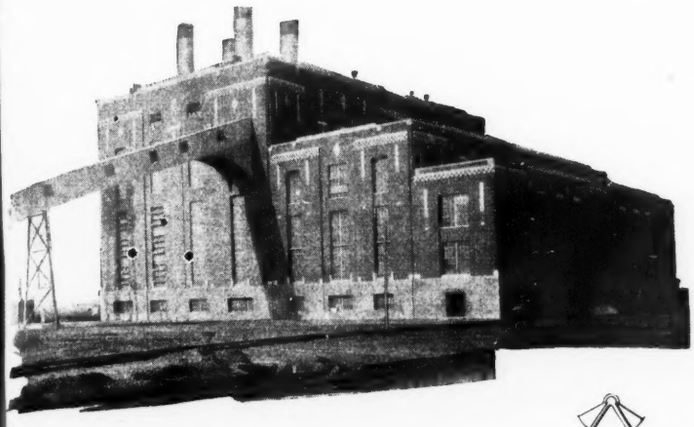
In the station, ease of operation is a feature of the design. The leisure time of the operator has also been considered. The company has built a group of fine homes in the village of Sayreville, about one-half mile from the plant. It is naturally expected that an employee satisfied with his environment will make a better workman.

Space is provided to accommodate eight boilers, four per turbine. For the present, however, only four boilers have been installed, as the initial load on the station will require the operation of only one unit. These boilers are of the cross-drum, sectional, all-steel, water-tube type built for a working pressure of 450 lb. To provide for an interdeck convection superheater, the steam-making surface is arranged in two banks of tubes 3 in. in diameter except those in the lower row, which are 4½ in. to better withstand the rough usage imposed by slag removal. Operating steam conditions at the boiler are 440 lb. pressure and a final temperature of 725 deg. F.

A maximum boiler output of 190,000 lb. of steam per hour is anticipated, which is equivalent to operation at 525 per cent of nominal rating, and to a capacity of 19,000 kw. Such intensive operation is to be secured through underfeed stokers equipped with link-grate overfeed sections and double-roll clinker grinders. The drive

With Low Investment Cost

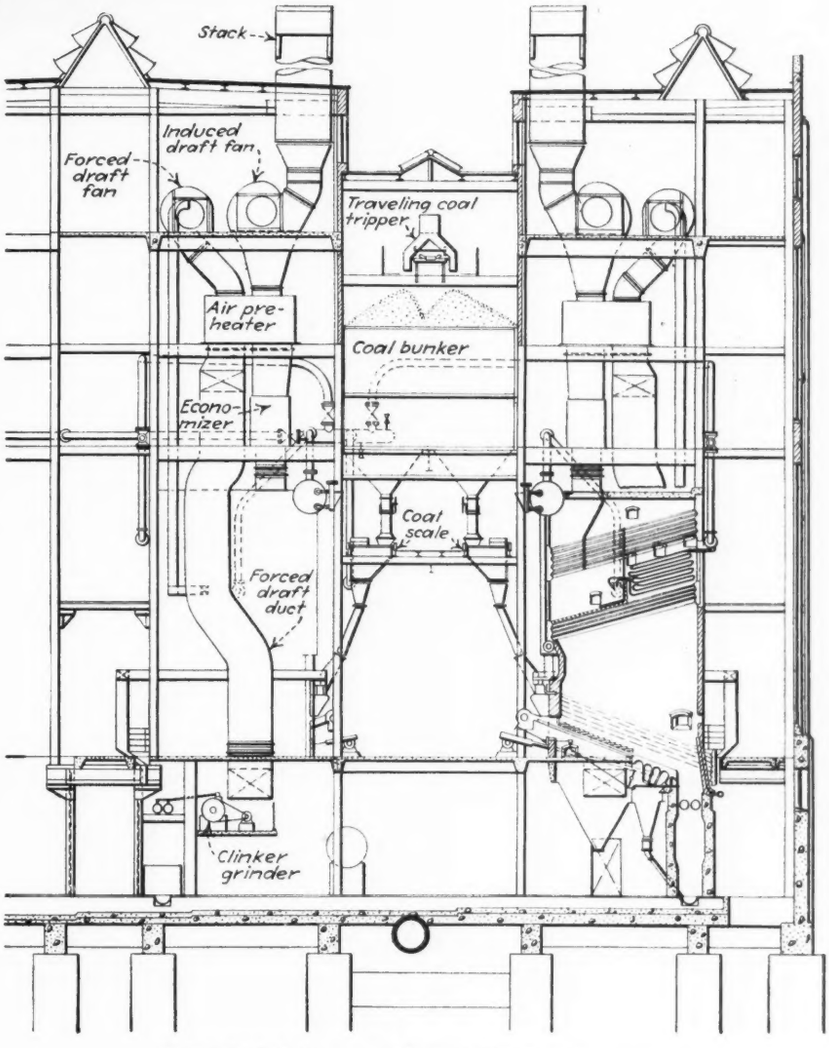
New 440-lb. stoker plant designed for high commercial economy, ease of operation and low investment. An outstanding feature is the exclusive use of squirrel-cage motors arranged for across-the-line starting at 2,300 or 440 volts. Auxiliary functions are split between units of different speeds



is a plain 440-volt squirrel-cage motor through an infinitely variable gear reduction. As already pointed out, constant-speed motors of this type are used throughout the plant. Simplicity of motor and control, low initial cost and low maintenance are the reasons for the exclusive use of this type of motor.

Pennsylvania bituminous coal averaging 13,800 B.t.u. per pound and analyzing 11 per cent ash, 1 per cent moisture, and a maximum of 1 per cent sulphur, is the fuel burned. With coal of this quality, little clinkering trouble is expected.

To burn the tonnage necessary for operation at high rating, the boilers have been set high to provide a furnace volume of 6,500 cu.ft. Protection is afforded the refractories by water cooling of the rear wall and of the side walls for a height of approximately 5 ft. above the grate and parallel with the fuel bed. Above the water-cooled section the side furnace walls and the front wall are air-cooled. Construction of the suspended air-cooled side walls is such as to form vertical ducts to which air is admitted from the room through dampered inlets. In its passage upward the air is preheated 80 to 150 deg. and is collected in a common metal duct leading to the



Stoker-fired boilers, operating at 440 lb. pressure, are equipped with economizers and regenerative air heaters

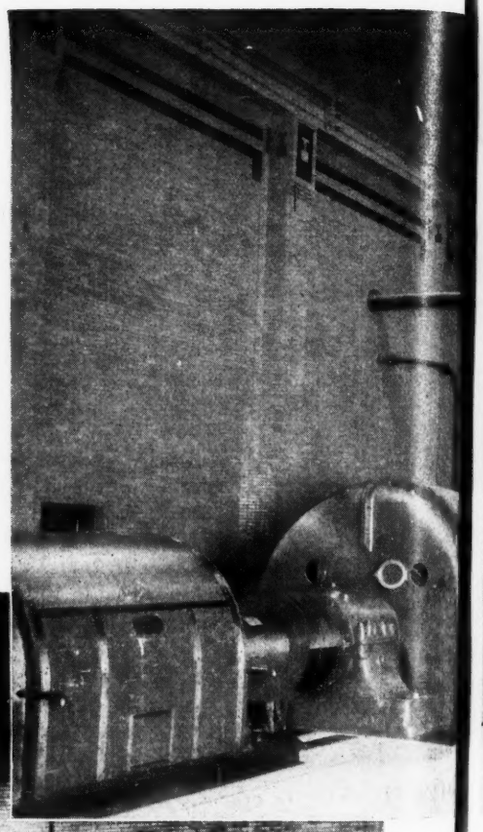
forced-draft fan of the individual boiler, to be passed through the fuel bed or introduced in smaller amounts over the fire.

Combustion is regulated automatically, the steam pressure being the controlling medium. Automatic coal scales weigh the fuel to each boiler, and non-segregating distributors deliver a uniform supply to each stoker hopper.

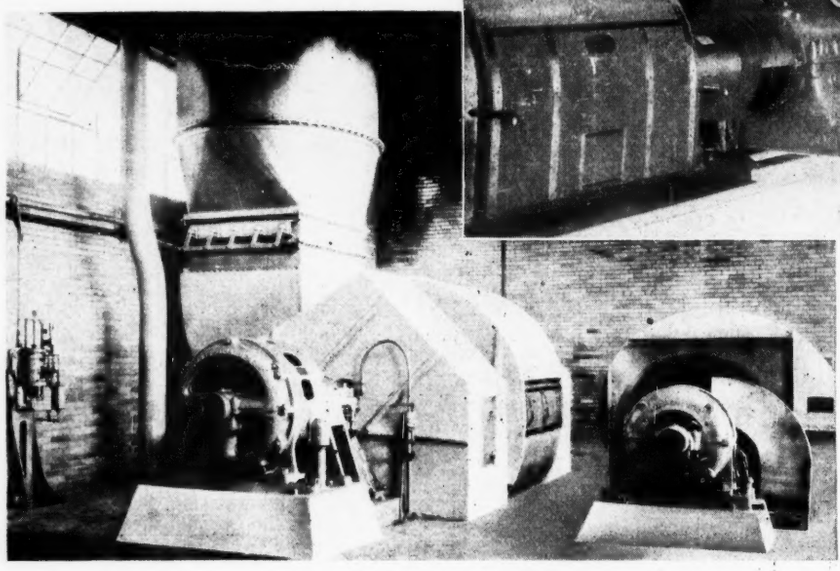
Preference was given to the vertical arrangement of boiler auxiliaries. Gases from the boiler pass directly upward, first through the economizer and then through the air preheater to the induced-draft fan, which delivers directly into the base of the stack.

Both forced- and induced-draft fans are arranged for two speeds by means of a dual drive of squirrel-cage motors, one motor at each side of the fan. In the case of the forced-draft fan, the synchronous speeds of the motors are 720 and 1,200 r.p.m., respectively. In the same order, the motors are rated at 40 and 125 horsepower. At normal operating load of 112,000 lb. of steam per hour the lower-speed motor is used. For the higher ratings the larger motor is needed, and the changeover from one to the other is made manually by means of a double-throw switch. Motors of 50 and 200 hp., with synchronous speeds of 514 and 900 r.p.m., respectively, drive the induced-draft fans.

The greater portion of the air for supporting combustion of the fuel passes through the fuel bed, but a small quantity is fed over the fire through nozzles in the rear and front walls. The temperature approximates 350 deg. at normal boiler rating. Part of this temperature is attained in the boiler side walls, from which the air passes to the forced-draft fan to be mixed with the general supply drawn in from the top of the boiler house.



Right—Two 30,000 kw. turbine generators exhaust to 28,000 sq.ft. single pass condensers



Below—Forced and induced-draft fans have dual motor drive

Main steam piping, with accompanying valves and fittings, is designed to withstand a working pressure of 450 lb. The feed-water lines are provided with 600-lb. standard equipment. Cast- and forged-steel valves and fittings are used, and the joints are of the raised-face type, with phonographic record finish to hold the gaskets.

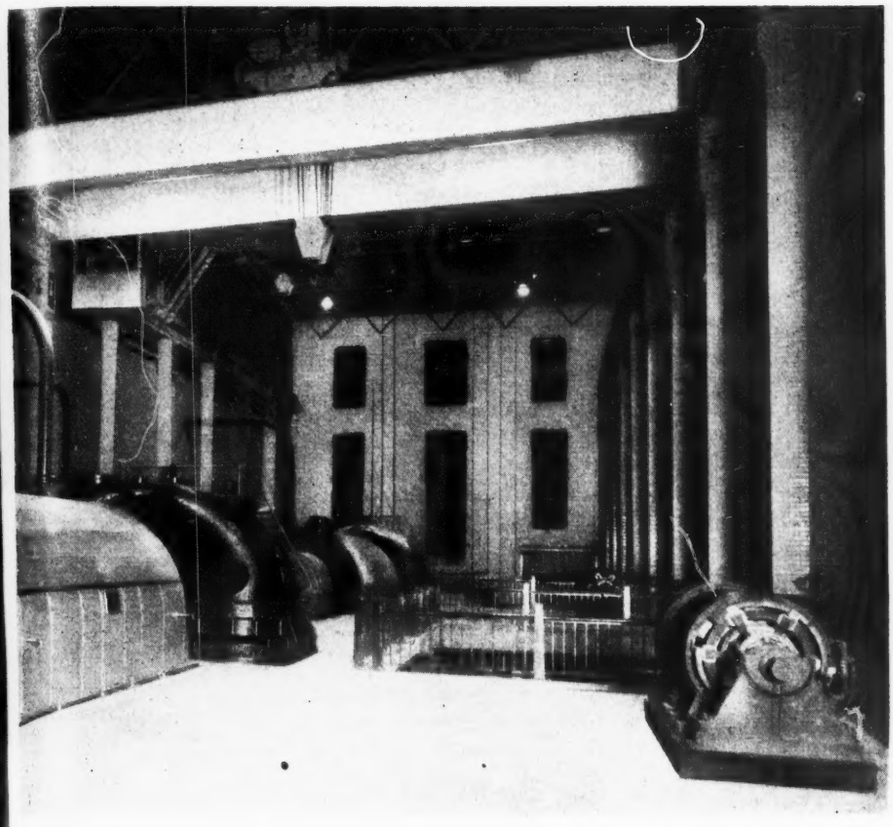
Steam from the four boilers of the unit is collected in a 20-in. manifold in which provision is made for the lead to the turbine and for cross-connection with the second unit group of boilers. In the cross-connection between the welded-steel headers and in the 12-in. supply lines to the turbines, the valves are motor-operated. An innovation is the use of an electrically operated pop safety valve on each header. With their accurate functioning and quick closing, it is expected that these valves will conserve steam that ordinarily would be wasted through the usual safety valves on the boilers.

Water for boiler make-up, cooling of bearings and drinking is drawn from the mains serving Sayreville. All other water for general use is pumped from the river. Deepwells on the premises may be the future supply. The city water is stored in a 50,000-gal. elevated steel tank, from which it is admitted to the make-up tank under float control. Booster pumps insure delivery to the storage tank from city main. Reference to the flow diagram will show the general arrangement. Another source of make-up supply is the low-pressure drains collected in tank *K*. Ordinarily, they are pumped under float control to the make-up tank, and if the supply exceeds the demand an overflow pump delivers the excess to storage.

In its passage to the open feed-water heater *G*, which is of the direct-contact deaërating type, make-up water first goes through heat exchangers *N* forming integral parts of the continuous blowdown systems of the boilers.

Although the boiler water supply is of excellent quality, it was considered desirable to use the soda-ash treatment supplemented by phosphate to avoid possible difficulties from scale. These chemicals are fed directly into the common suction of the boiler-feed pumps, shown at *H* in the diagram.

The turbines are arranged for extraction at four points for stage feed-water heating, but only three stages are used simultaneously, the lower stages at moderate to full load and the three higher stages when the turbine is operating at lower loads. From the ejector condenser the condensate passes through the generator air coolers and the low-pressure closed heater to the deaërating heater. The boiler feed pumps take their suction from the deaërating heater; and force the supply through the



high-pressure closed heater and the economizer to the boiler. Temperature of the feed water approximates 290 deg. entering the economizer, and 346 deg. entering the boiler.

The unit group of four boilers at present installed is served by two motor-driven centrifugal feed pumps of sufficient capacity to handle the entire load, and one steam-turbine-driven pump of the same capacity is a spare. Here again constant-speed induction motors are used, the feed-water supply being controlled by regulators at the boilers.

Arrangements have been made to receive coal by rail or water. This required the construction of approximately 1,500 ft. of dock on the river bank and 1½ miles of spur track connecting with the Raritan River Railroad. In handling coal from barges a portal crane through a future traveling hopper to be mounted on it will deliver to a system of belt conveyors leading to the crusher house. Located 225 ft. from the boiler plant, this crusher house forms a convenient junction point to receive water- or rail-borne coal and deliver it to belt conveyors rising up and running over the bunkers in the boiler room. Coal not intended for early use may be placed in open storage by means of a bucket elevator in the crusher house, a conveying spout discharging the coal to the ground and a drag scraper carrying it to the pile. Recovery is by means of the scraper. The coal passes through the crusher and on to the bunkers in the usual way.

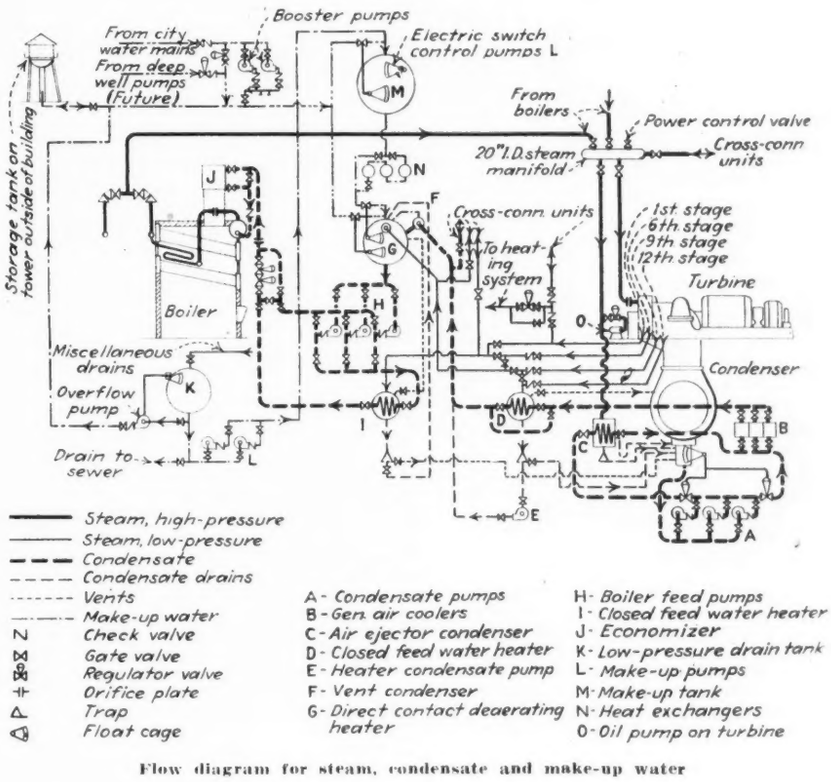
From the hoppers under the boilers ashes are sluiced to a central sump from which they are pumped to the low ground on the site.

Reference has been made to the two 30,000-kw. turbine generators. The turbines are designed to operate on steam at 400 lb. pressure and 700 deg. F. final temperature, with provision for extraction at four points. Each machine is equipped with a single-pass condenser having 28,000-sq.ft. of heating surface, or 0.89 sq.ft. of surface per kilowatt.

Main condenser auxiliaries consist of two circulating pumps and three condensate pumps, each machine being driven individually by a constant-speed squirrel-cage motor. Each of the circulating pumps has sufficient capacity to insure full vacuum at considerably over half load in warm weather and full load during the winter months. Two condensate pumps care for full load on a unit, leaving a spare at all times of a little over half capacity.

Circulating water is brought in from the river through two concrete pipe lines per unit, each 5½ ft. in diameter, and the return to the river is through pipes of the same diameter into an open canal discharging downstream.

Three-phase, 60-cycle current is generated at 13,800 volts and stepped up to 66,000 volts through transformers connected directly to the generator in an outdoor



Flow diagram for steam, condensate and make-up water

Mechanical Equipment in Raritan River Plant

General

Location ..... Sayreville, N. J.
Operating company .... Eastern New Jersey Power Company
Engineers and constructors
The Management & Engineering Corp.
Holding company ..... Utilities Power & Light Corporation
Present capacity, kw. 60,000
Ultimate capacity, kw. 180,000

Boilers and Auxiliaries

Boilers, four, cross-drum, 11,810 sq.ft.; 440 lb. working pressure; max. output, 190,000 lb. of steam per hour
Springfield Boiler Co.
Superheaters, four, Elesco, 2,540 sq.ft. each; final steam temperature, 725 deg. F. ..... Superheater Co.
Air preheaters, four, Ljungstrom, 17,800 sq.ft.; air heated to 350 deg.; drive, 2-hp. motor through Jones worm speed reducer ..... Air Preheater Corp.
Economizers, four, each 3,840 sq.ft.; exit temperature of water, 346 deg. F. ..... Foster-Wheeler Corp.
Stokers, four, underfeed with link-grate overfeed section; 10 retort; projected area, 348.6 sq.ft.; drive, 20-hp. 440-volt induction motor through Universal Gear Corp's variable speed reducer ..... Westinghouse Elec. & Mfg. Co.
Coal distributors, eight, non-seg. ..... Rolland-Gardner & Co.
Coal scales, eight, 6 tons per hr. each .. Richardson Scale Co.
Weightometer, one, E type, on belt .. Merrick Scale Mfg. Co.
Coal valves, eight, dustless, 14 in. sq. ..... Henry Pratt Co.
Furnace air-cooled walls, suspended type, each 598 sq.ft.
Drake Non-Clinkering Furnace Block Co.
Furnace water-cooled surface, armor-clad tubes thermo-fit blocks and bare tubes; each 606.5 sq.ft.
Drake Non-Clinkering Furnace Block Co.
Steam purifiers, four ..... International Filter Co.
Soot blowers, valve-in-head .. Diamond Power Specialty Corp.
Combustion control system ..... Hagan Corp.
Fans, forced-draft, four, double-inlet; 53,000 c.f.m., 80-deg. air, against static head 8.3 in. water; dual drive, 125-hp., 1,200-r.p.m., 2,300 volt motor and 40-hp., 720-r.p.m. 2,300-volt motor ..... Green Fuel Economizer Co.
Fans, induced-draft, four, super-duplex; 107,000 c.f.m., 364-deg. gas, against 7.2 in. water pressure; dual drive, 200-hp., 900-r.p.m., 2,300-volt ind. motor and 50-hp., 514-r.p.m., 2,300-volt induction motor ..... Green Fuel Economizer Co.
Pumps, boiler feed, three, six-stage, 5x4 in., 400 g.p.m., hd. 1,373 ft.; drives, one 220-hp. Terry turbine and two 250-hp. 2,300-volt squirrel-cage motors .... Allis-Chalmers Mfg. Co.
Ash-sluicing system with two manganese steel ash pumps driven by 100-hp. motors and one double-roll clinker grinder driven by 15-hp. motor .... Allen-Sherman-Hoff Co.
Coal-handling system, 250 tons per hr.
C. O. Bartlett and Snow Co.
One track hopper; one duplex reciprocating plate feeder, 45 in. wide, 24 ft. long, 10-hp. motor, 1,200 r.p.m.; one belt conveyor, 36 in. wide, 226 ft. long, inclined 13 deg., speed 250 ft. per min., 20-hp. motor, 1,200 r.p.m.; one single reciprocating plate feeder, 42 in. wide, 6 ft. long, 7½-hp. motor, 1,200 r.p.m.; one bucket elevator, 56 ft. high, 36 in. wide, 30-hp. motor, 900 r.p.m.; one belt conveyor, 30 in. wide, 310 ft. long, inclined 18 deg., speed 350 ft. per min., 40-hp. motor, 1,200 r.p.m.; one belt conveyor over bunker, 30 in. x 80 ft., speed 350 ft. per min., 7½-hp. motor, 1,200 r.p.m.; one aut. self-propelling rev. coal tripper, traveling 50 ft. per min.
Coal crusher, one, ring type, 250 tons per hour, 100-hp., 2,300-volt motor, 600 r.p.m. ..... American Pulverizer Co.
Drag scraper conveyor, 225 tons per hour; tail car propelled by 20-hp. d.-c. motor operated from battery car; power unit driven by 150-hp. 2,300-volt motor ..... Sauerman Bros.

Turbine Room

Turbine-generators, two, 30,000 kw. 1,800 r.p.m.; generators 3 phase, 60 cycles, 13,800 volts; direct-connected 1,500-kw. 2,300-volt aux. generator with direct-connected exciter
General Electric Co.
Generator air coolers, two, double-bank, condensate and raw water, 11,420 sq.ft. each, for main units; two 2,100 sq.ft. coolers for aux. generators ..... Griscom-Russell Co.
Condensers for main units, two, single-pass, 28,000 sq.ft.
Westinghouse Elec. & Mfg. Co.
Circulating pumps, four, 23,500 g.p.m., 13.92 ft. head; 125-hp. 2,300-volt motor, 245 r.p.m. .. Westinghouse Elec. & Mfg. Co.
Condensate pumps, six, 345 g.p.m., 180-ft. head; 30-hp. 2,300-volt motor ..... Westinghouse Elec. & Mfg. Co.
Air ejectors, two 2-stage ejectors per condenser, inter- and after-condenser; cap. 38.3 c.f.m.,
Westinghouse Elec. & Mfg. Co.
Turbine-generator, one, 500 kw., 2,300-volt for emergency starting ..... Westinghouse Elec. & Mfg. Co.
Exciter sets, two 175-kw. 250-volt; 265-hp. 2,300-volt ind. motor ..... Westinghouse Elec. & Mfg. Co.
Exciter set, one, 175-kw., 250-volt; dual-drive, 265-hp. 2,300-volt ind. motor and 265-hp. turbine
Westinghouse Elec. & Mfg. Co.
Oil filters, two, capacity 500 to 1,000 gal. per hr.; one 4,000-gal. 2-compartment clean and dirty oil tank; two ¾-in. rotary oil pumps, drive ¾-hp. motor; one 2-in. rotary pump, 75 g.p.m., 5-hp. motor ..... S. F. Bowser & Co.
Water screens, traveling, four, each 7 ft. 10 in. wide, 26 ft. centers; 5-hp. motor, 1,150 r.p.m., Universal Gear Corp. speed reducer ..... Chain Belt Co.
Screen wash pumps, two, single-stage, 295 g.p.m., 210-ft. head; drive, 25-hp. 440-volt motor, 3,600 r.p.m.
Worthington Pump & Mach. Corp.

Heaters

Extraction heaters, low pressure, two, 270,000 lb. water per hr. from 94 to 163 deg., steam pressure 6.1 lb. abs.
Croll-Reynolds Engineering Co.
Extraction heaters, high-pressures, two, 343,000 lb. water per hr. from 235 to 291 deg., steam pressure 64.4 lb. abs.
Croll-Reynolds Engineering Co.
Open, direct-contact deaërating heater, two, 340,000 lb. per hr. condensate from 160 to 235 deg. and 10,000 lb. per hr. make-up from 70 to 235 deg., steam pressure, 23.3 lb. abs; vent condenser with 132 sq.ft. surface ... Hoppes Mfg. Co.
Hot-water heater, domestic ..... Whitlock Coil Pipe Co.
Extraction heater drainers, four ..... Atwood-Morrill Co.
Heater drain pumps, 2-stage, two, 45 g.p.m., 170 deg. water, 94 ft. discharge hd. .... Worthington Pump & Mach. Corp.
Heat exchanger, continuous blowdown, 3-section unit; cool 7,000 lb. per hr. from 458 to 90 deg. ..... Swartwout Co.

Miscellaneous Pumps

Pumps, make-up water, two, 40 g.p.m., 100-ft. hd.; 3-hp. 440-volt motor ..... Worthington Pump & Mach. Corp.
Pumps, booster, two, 300 g.p.m., 92.5-ft. hd., 15-hp. 440-volt motor, 1,750 r.p.m. ..... American Steam Pump Co.
Pumps, service, two, 4-in. self-priming, 420 g.p.m., 72-ft. head, 15-hp. 440-volt motor ..... Nash Engineering Co.
Pumps, overflow from drain tank, one, 1½-in., 75 g.p.m., 162-ft. hd., 7½-hp. 440-volt motor, 3,450 r.p.m.
American Steam Pump Company
Bilge pumps, two, heavy-duty duplex, aut. draining condenser pits; cap. each pump, 200 g.p.m., 20-ft. hd.; 2-hp. 440-volt ind. motor, 1,150 r.p.m. ..... Yeomans Bros. Co.
Bilge pump, one, aut. elec., draining pit below track coal hopper; 50 g.p.m., 24-ft. hd. ..... Yeomans Bros. Co.
Bilge pump, one, aut. elec., draining pit in crusher house; 50 g.p.m., 34-ft. hd. ..... Yeomans Bros. Co.

Cranes and Air Compressors

Crane, one, 4-motor electric, traveling, 75 tons with 10-ton aux. hoist, 60-ft. lift ... Shepard-Niles Crane & Hoist Corp.
Chain hoist, one, 6-ton with 16-ft. travel, for removing circulating pump casing ..... H. Channon Co.
Air compressor, one, belt-driven duplex, 2-stage, 285 c.f.m., 125 lb., 60-hp. 2,300-volt motor ..... Ingersoll-Rand Co.
Air compressor, one, single-stage, 7x7-in., 68.5, c.f.m., 100 lb.; 15-hp., 440-volt motor, 1,750 r.p.m. .. Ingersoll-Rand Co.

Valves and Piping

Valves, steam, 450 lb. cast steel ..... Walworth Co.
Valves, water, 600 lb. cast steel ..... Walworth Co.
Valves, low pressure, cast steel ..... Walworth Co.
Forged steel valves, high pressure — Henry Vogt Machine Co.; Edward Valve & Mfg. Co.; Walworth Co.
Pipe and fittings — National Valve & Mfg. Co.
Power control valves ..... Consolidated Ashcroft Hancock Co.
Motor control for valves ..... Cutler-Hammer Inc.
Boiler safety valves ..... Crosby Steam Gage & Valve Co.
Misc. safety valves ..... Crane Co.
Blowoff valves ..... Yarnall-Waring Co.
Circulating-water valves ..... Chapman Valve and Mfg. Co.
Portable Limitorque machine for operating circ. water valves
D. H. Skeen & Co.
Reducing valves ..... Swartwout Co.
Float valves ..... Swartwout Co.
Bleeder check valves ..... Atwood & Morrill Co.
Insulation ..... Philip Carey Co.

Instruments

Steam- and water-flow meters ..... Republic Flow Meters Co.
CO_2 recorders ..... Republic Flow Meters Co.
Draft gages ..... Ellison Draft Gage Co.
Indicating pressure gages .. Consolidated Ashcroft Hancock Co.
Thermometers, indicating ..... C. J. Tagliabue Mfg. Co.
Thermometers, recording . Consolidated Ashcroft Hancock Co.
Barometer and vacuum recorder ..... Uehling Instrument Co.
Condenser leakage recorder ..... Leeds & Northrup Co.
Vibrating tachometers ..... James G. Biddle
Meter panels, boiler and turbine room
Consolidated Ashcroft Hancock Co.
Rolling steel doors for meter panels ..... Kinnear Mfg. Co.

Miscellaneous Equipment

Passenger elevator ..... Westinghouse Elec. Elevator Co.
Fireless locomotive ..... H. K. Porter Co.
Steam traps — Swartwout Co.; Warren Webster & Co.
Float boxes ..... Swartwout Co.
Drainage control system ..... Swartwout Co.
Feed-water regulators ..... Swartwout Co
Continuous blowdown equipment ..... Swartwout Co.
Water strainers ..... Elliott Co.
Atmospheric relief piping ... Semet-Solvay Engineering Corp.
Expansion joints, copper ..... Griscom-Russell Co.
Expansion joints, rubber ..... U. S. Rubber Co.
Elevated water tank, 50,000 gal. . Chicago Bridge & Iron Wks.
Miscellaneous tanks ..... Pittsburgh-Des Moines Steel Co.
Flues, uptakes, air ducts, etc. . Sheet Metal & Conveyor Corp.
Floor grating ..... Tri-Lok

Building

Brick ..... Sayre-Fisher Brick Co.
Structural steel ..... American Bridge Co.
Window sash ..... Bogert & Carlough Co.
Glazing ..... Pittsburgh Plate Glass Co.
Roofing ..... Johns-Manville Corp.
Floor, turbine room .. .. Kalman Floor Co.

switchyard. Here a double-bus arrangement with seven circuits is provided, each circuit being equipped with two 66,000-volt oil circuit breakers.

Each generator is equipped with air coolers and CO_2 fire protection equipment. Direct-connected house generators rated at 1,500 kw. and 2,300 volts provide a reliable and efficient source of power for the auxiliaries. A 500-kw. non-condensing turbine-generator serves as a stand-by unit to provide starting current for the auxiliaries when no other source of power is available on the system.

Excitation for each main unit is provided by a 175-kw., 250-volt, motor-driven exciter set, and in addition a spare exciter with dual turbine and motor drive may be used with either machine.

Power for the station auxiliaries is furnished, for the most part, at 2,300 volts, and normally is supplied by the house generators. In emergencies auxiliary power is available from a bank of service transformers operating from the 66,000-volt bus, or from the 500-kw. machine. Motors of 50-hp. rating and over use 2,300-volt energy, and the smaller motors operate at 440 volts. Boiler-room auxiliaries are supplied from a double 2,300-volt bus equipped for automatic changeover in case of bus failure. Full-voltage starting prevails, the bus switch also functioning as the starting switch for the motor. Push-button control is provided at the motor and other convenient points. General station service switching is in the main switch room, which has 2,300-volt armor-clad switchgear. The main control boards are made up in a special cubical design involving the use of hinged-type swinging panels. The switchboard is arranged in three groups, one for the control of station service circuits, one for the control of high-tension circuits, and a bench section for the control of the main units and the house generators.

▼▼▼

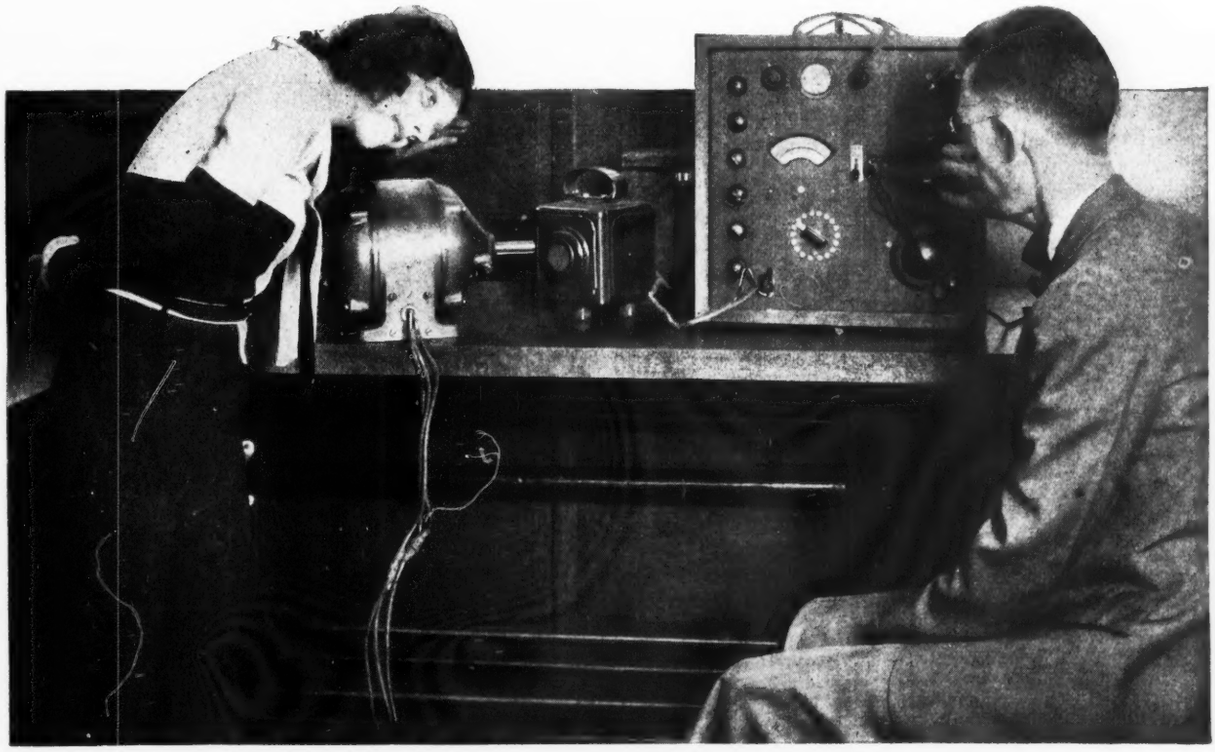
"Electric Ear" Detects Machinery Noises

AN "ELECTRIC EAR" to separate the various sounds of power machinery was recently demonstrated at the Westinghouse Research Laboratories by J. P. Foltz, who developed it.

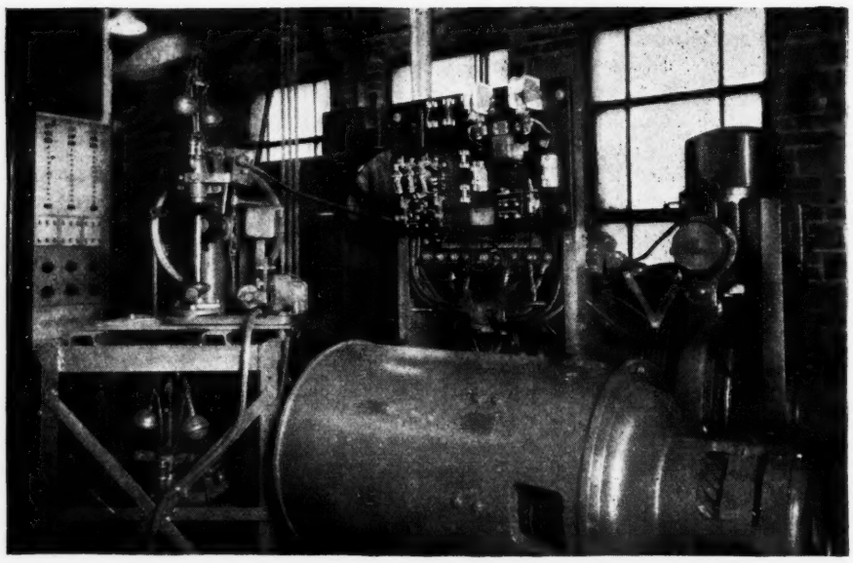
The new device consists of a microphone, an amplifier of several stages to raise the energy level, a filter circuit that permits only one frequency at a time to pass, a meter for reading amplitudes, and batteries to furnish power. The complete equipment weighs about 60 lb. and is independent of any outside current supply.

The microphone may be of either the electro-dynamic or condenser type. It is connected to the sound analyzer by a wire and plug. By turning certain knobs and dials, sensitivities on the selector from one to 10,000 are possible. Frequency ranges from 60 to 7,000 cycles can be obtained.

Although not yet in commercial production, this latest vibration detector should eventually prove of great value in the noise-abatement efforts rapidly being initiated in many communities throughout the country.



This sound-detection equipment, to separate the various noises made by power machinery, weighs only 60 lb. and can be fit into an ordinary suitcase



Lower elevator machine operates the top car. This machine is of the standard type with a single traction sheave. The motor-generator set is in the foreground and the two governors and differential safety are on the left.

OPERATING TWO ELEVATOR CARS

Considerable speculation has been centered around the possibilities of operating two elevator cars in one hoistway. This article tells how it is being done in the first commercial installation of its kind. The two cars run on the same guide rails, and another set of guide rails serve the two counterweights

ELEVATOR HOISTWAYS in a building reduce the rental space and place a definite limit on its economical height. For example, in a 20-story building having 50 sq.ft. for each hoistway there is 20×50 or 1,000 sq.ft. of floor space required for each elevator. If, however, two elevator cars are operated in each hoistway, only about one-half this space is required per elevator, also one-half the number of inclosure doors, signals, etc., will be needed. If the space saved per elevator can be rented at $4 per sq.ft. per year the income will be increased $2,000, which is 10 per cent on $20,000. Dual elevators, consequently, seem highly desirable.

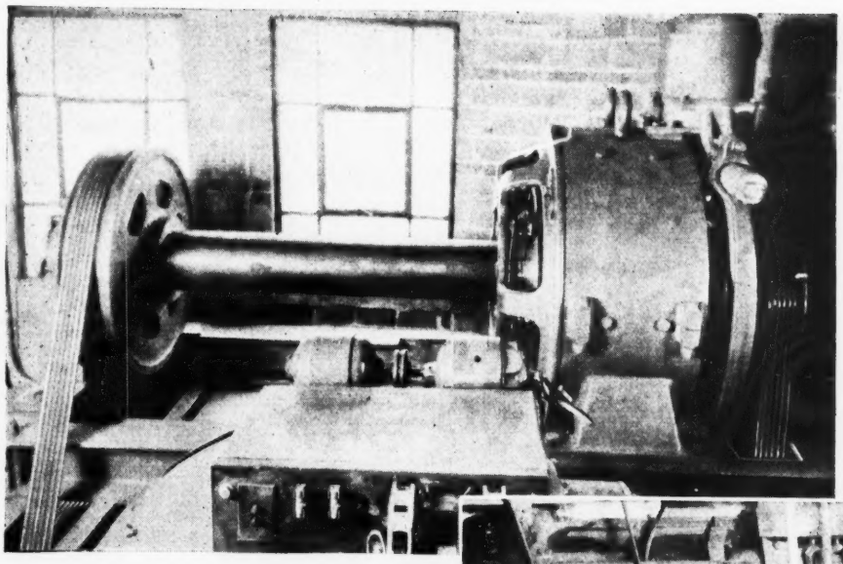
The first installation where two independent elevators are operated in one shaftway on a commercial basis has been put into operation in the new office building of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Each elevator car is rated at 3,000 lb. at 600 ft. per min. A floor-button system of control is used and the cars are full-automatic in operation. In each car is a set of buttons corresponding to the floors served. At each landing are two sets of buttons for calling either the upper or lower car. The top car operates from the third to the eleventh floors, and the bottom car from the first to the ninth floors. Sufficient headroom has been provided to park the upper car during inactive periods of the day and permit the lower car to serve ten floors.

When running two elevator cars in the same hoistway, the question of safe operation is uppermost. Obviously, both cars should run in the same direction, on a fixed schedule. Nothing can be gained by trying to run the cars in opposite directions except under abnormal conditions. Provision is made in each car to change the control from automatic to hand operation, which will permit slow movement of either car toward the other. This provision is intended to be used only in case of emergency or if the automatic control fails to land the car properly.

When one car is operated in the hoistway, automatic means stop it before it reaches the limits of travel. When two cars are operated in the same hoistway, each car becomes the limit of travel for the approaching car, and, in general, the same safety means stop the approaching car before it reaches the limit of its travel.

The cars are normally operated on a block system of control similar to that for subway trains. When one car approaches the other, it is first slowed down and then stopped by the same control that is used for its normal operation. The operator has a set of three signal lights. A green light indicates that the car can run full speed; an amber light is a caution signal requiring half speed; a red light means stop. These three lights guide the operator and indicate one car's position relative to the other.

Differential gearing at the top of the hoistway is provided with two elements, one of which is attached to each car by a steel tape. Automatic devices stop both cars if either steel tape becomes slack. The differential gearing indicates the relative positions of the cars

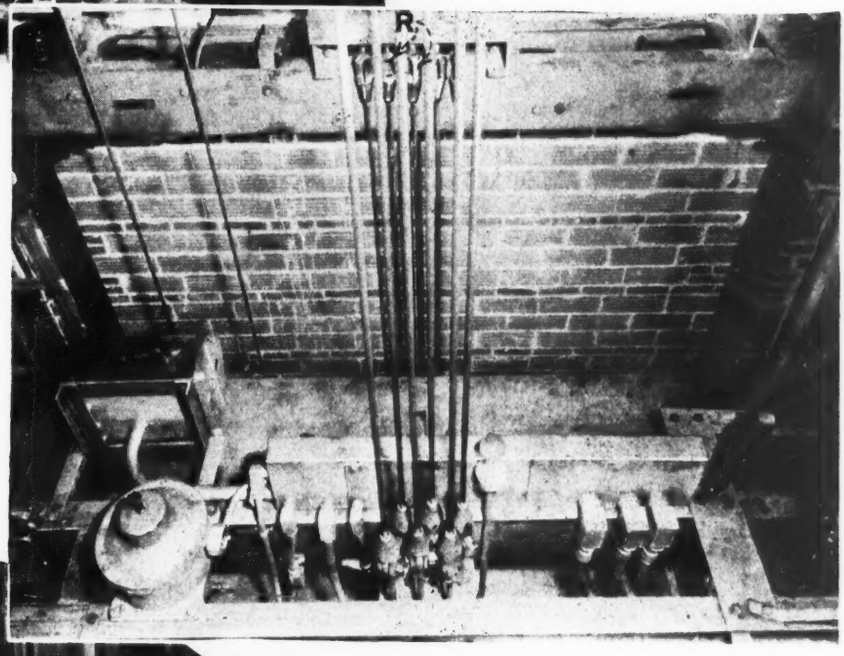


Left—Top elevator machine operates the lower car. The traction sheave for the hoisting ropes is divided and placed at opposite ends of the machine, there being three hoisting ropes on each sheave.

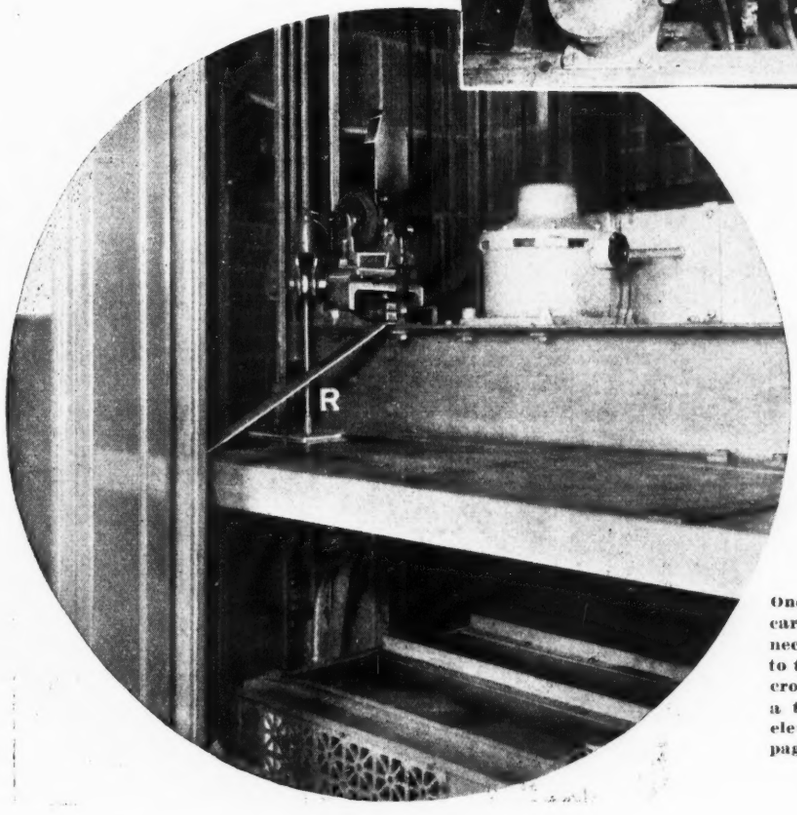
IN ONE HOISTWAY

By H. D. JAMES

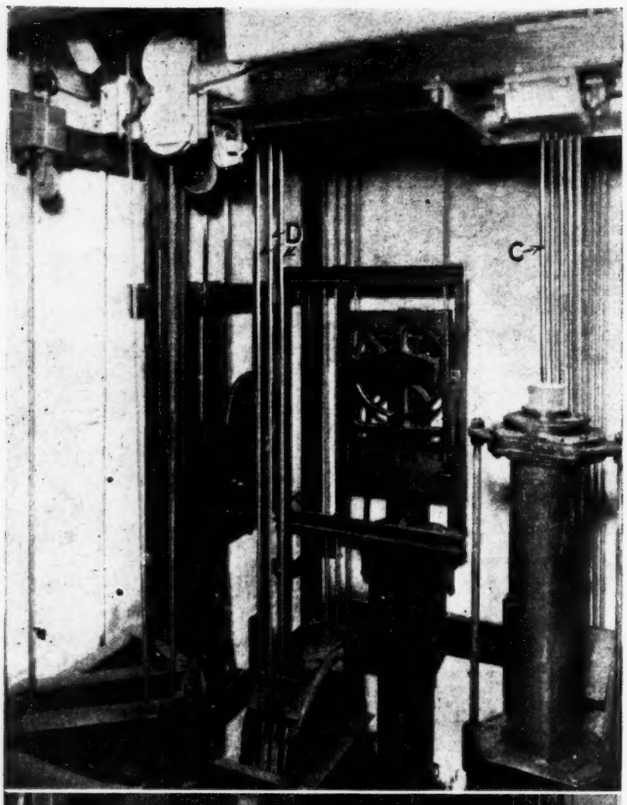
Consulting Control Engineer
Westinghouse Elec. & Mfg. Co.

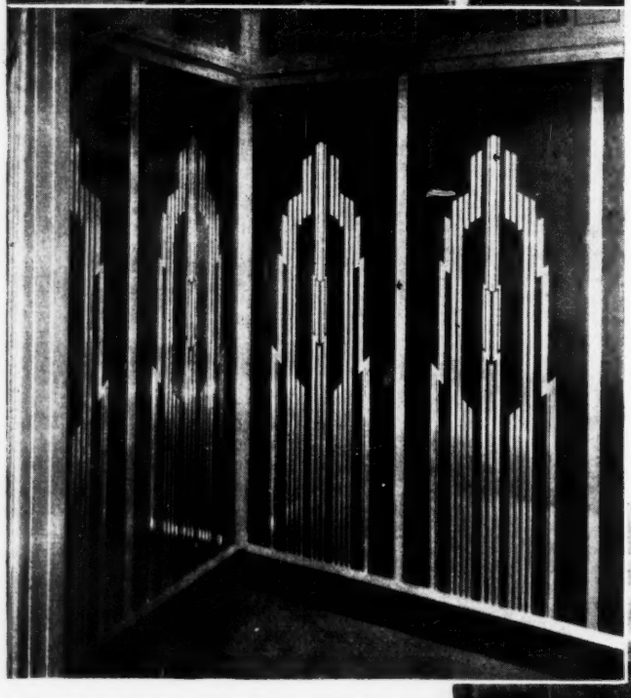


Top of the upper car: the six hoisting ropes connect to the center of the crosshead and go to the traction sheave on the lower elevator machine. The bottom car counterweight safety can be seen at the top of the picture, with the compensating rope from the car connected at R



One end of the crosshead for the lower car. Three of the hoisting ropes connect at R and the other three connect to the diagonally opposite corner of the crosshead. The hoisting ropes go over a traction sheave at each end of the elevator machine, as at the top of this page, and down to the ends of the top counterweight crosshead





Top—The elevator hoistway pit. The compensating ropes for the lower car are at C and three of these ropes for the top car are at D

Above—Inside one of the cars, which are made of aluminum and Micarta

Right—The top counterweight, which is attached to the bottom car. The hoisting ropes to the lower counterweight are at R. The counterweight safety is at the bottom of the picture.

and operates to slow down and stop the approaching car if the block system fails. The action is selective, and the leading car does not have its control interfered with. Every facility is provided for the leading car to clear the block and provide safe running space for the following car. The speed of the approaching car is reduced and the car finally stopped in three stages by the differential gearing as follows:

1. Separate electrical connections are established for reducing the speed of the car. These operate on a separate circuit from the normal control circuit, so that it will remain effective even if the normal control circuit becomes disarranged.

2. If the car continues to approach a dangerous position the emergency stop circuit is set, which applies both dynamic and mechanical braking to the elevator machine.

3. The differential gearing is connected to the governor in such a way as to reduce the tripping speed of the governor for the approaching car so that the car safeties will be tripped if it enters a dangerous position at an unsafe speed.

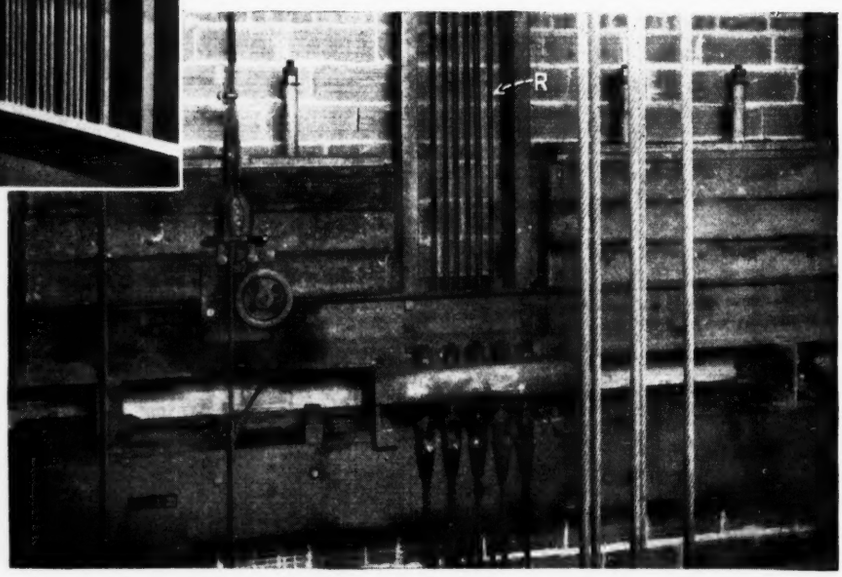
Oil buffers stop the cars at either limits of travel. In addition, an oil buffer is placed between the two counterweights to prevent shock if the two cars drift together. At the same time a set of emergency switches, located between the cars, are operated to disconnect the power.

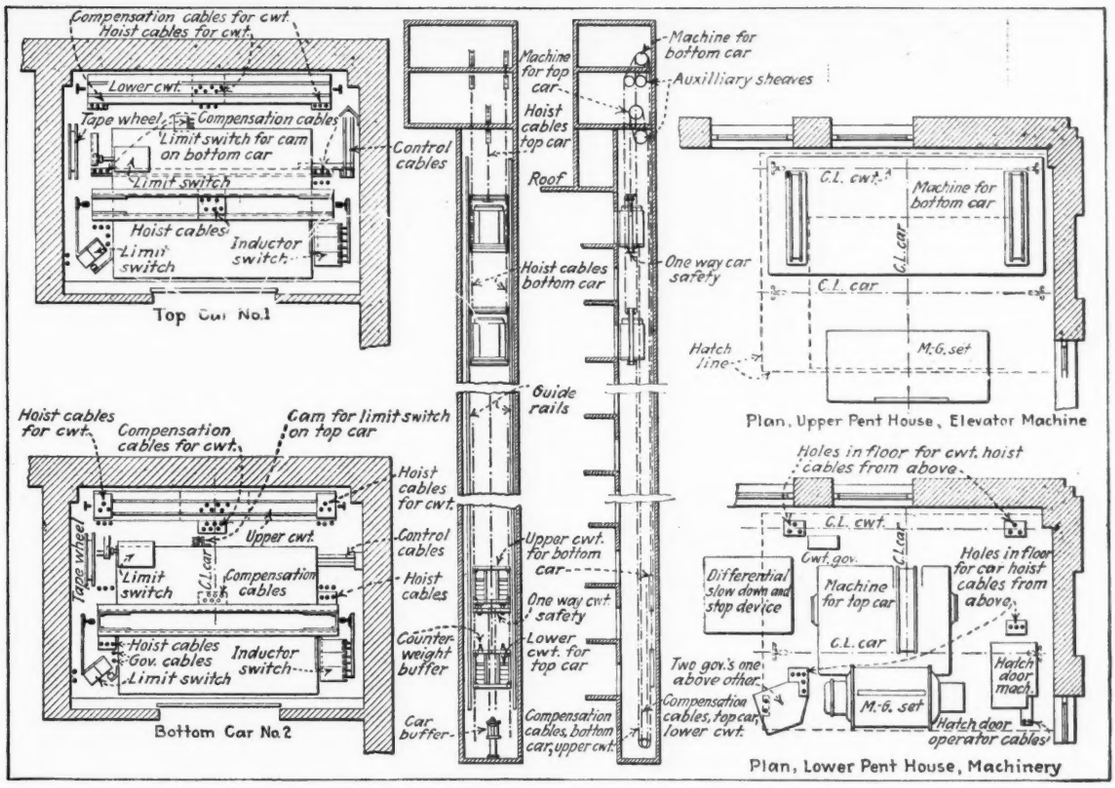
The two counterweights are operated on the same set of rails. The upper is provided with a safety to prevent its dropping on the lower counterweight in event the ropes break. Experience shows that all the hoisting ropes on traction machines do not break, but it was thought advisable to provide this safety.

The car safety is a recent improved design. It is set by a very small movement of the car after the governor trips. The initial pressure of the jaws against the rail is applied through a spring. A further movement of the car causes the jaws to grip the rail with increasing force. If the ropes remain intact it is probable that the first application of the safety will bring the car to rest without a severe strain on the passengers.

A safety switch in each passenger car allows the operator to set the emergency circuit if necessary.

Roping of the machines and the arrangement of the compensating ropes and electrical cable connections are





Plans and elevations of the two elevators in one hoistway

very interesting and are given in the diagram. When this hoistway was designed it was thought advisable to provide considerable clearance around the cars, as difficulty was anticipated in arranging for the different ropes and cables. Experience gained on this installation shows that a saving can be made in the size of the hoistway, but the dual elevator will require more clearance than a single-car installation.

Hoisting ropes for the lower car lead down each side of the top car and are attached to the crosshead of the bottom car at each end on opposite sides of the center line passing through the guide rails. The other end of the hoisting ropes is attached to the outer ends of the counterweight. The distance between counterweight rails is approximately the same as between car rails. The top counterweight is attached to the bottom car.

On the top car the hoisting ropes are attached at the center of the crosshead and lead to the bottom counterweight through a slot in the upper counterweight. This arrangement is similar to the old drum machines using a separate car counterweight.

From the bottom car the compensating ropes are attached to the top counterweight. The compensating ropes for the top car pass down either side of the bottom car and attach to the ends of the bottom counterweight. Considerable ingenuity was exercised in locating the governor ropes and electric cables in reference to the cars.

Aluminum was used wherever reduced weight improved operation. The car slings and platform framing are made of aluminum. A combination of aluminum and micarta gives the car inclosures an unusual and attractive appearance. The saving in weight of the cars and slings is large. This reduces the power required to operate the machines and decreases the stresses on the equipment and supporting structure. The decreased effort required for stopping the light-weight cars is an important safety consideration and should be given serious attention on all elevator installations.

The hoistway doors are made of aluminum, with micarta panels. These doors weigh about one-half as much as ordinary steel doors and consequently require only one-half the energy to operate them. If they should come in contact with a passenger they can be stopped quickly and safely.

Improved operation of this elevator equipment with the use of aluminum for the cars, car slings, and hoistway doors will undoubtedly lead to its use on many other installations. Its combination with micarta in various colors opens up a new field of design.

The floor selectors for both cars are mounted together in the penthouse and attached to a pair of miniature elevators operating in an illuminated hoistway, with ground glass front. Each floor is indicated, and all the parts are to scale, so that it is easy to follow the operation of the two cars. A duplicate set of control stations is provided close to the miniature hoistway, so that the control of the cars can be transformed to these stations and the elevators operated in any desired manner. Duplicates of the signals and hall buttons permit observation of the complete operation.

This initial installation has developed many interesting engineering details that have led to improvements in operation. Experience shows that fewer safety devices will be sufficient, but when a new departure of this kind is undertaken it is desirable to be on the safe side. Dual elevators are safer in operation than the ordinary single elevator. Some of the safety devices introduced on this installation are applicable to single elevators, and many prove desirable on high-rise, high-speed installations, many of which are now being built. The speed of these passenger elevators has been materially increased without many additions to the mechanical safeties used for slower-speed equipment.

INSULATION for High Temperatures

By E. F. ZEINER
The Philip Carey Company

In the Nov. 18 number Mr. Zeiner discussed commercial insulations suitable for temperatures up to 600 deg. In this article insulations for higher temperatures are covered

PREVIOUS articles of this series stressed the importance of limiting the use of the highly efficient insulations of the laminated or multi-ply type and 85 per cent magnesia of the molded type to temperatures below 500 and 550 deg. F., respectively. Above that range these highly efficient insulating materials must be protected from the destructive effects of high temperatures by other materials capable of greater heat resistance.

Consideration of suitable high-temperature insulating materials should be made with those factors in mind that influence satisfaction and reliability of service. These important factors are:

1. *Insulating efficiency.*
2. *Mechanical strength* to withstand shipping, handling and application.
3. *Low heat shrinkage*, so that the less-heat-resistant, high-efficiency coverings will be properly protected.
4. *Resistance to decomposing effect of high temperature* to insure reasonable life.
5. *Resistance to the effects of moisture*, necessary where such materials are transported by boat and where poor storage facilities exist.
6. *Weight*; pounds per cubic foot is sometimes an important item, especially when considered in terms of freight charges, and where the load on piping is to be minimized.

Some varieties of pure asbestos will withstand temperatures of 1,200 deg. without decomposition, but asbestos, like any form of rock, transmits heat rapidly. Finely fiberized asbestos, due to the finely divided air spaces, has fairly good insulating value. However, to mold such asbestos into usable shapes it is necessary to bond it with heat-resistant adhesives. The use of such bonding material considerably increases the rate of heat transmission and as a result this type of insulation does not compare favorably with other forms of insulation.

Felted asbestos was used extensively as high-temperature insulation until recent years, when more efficient

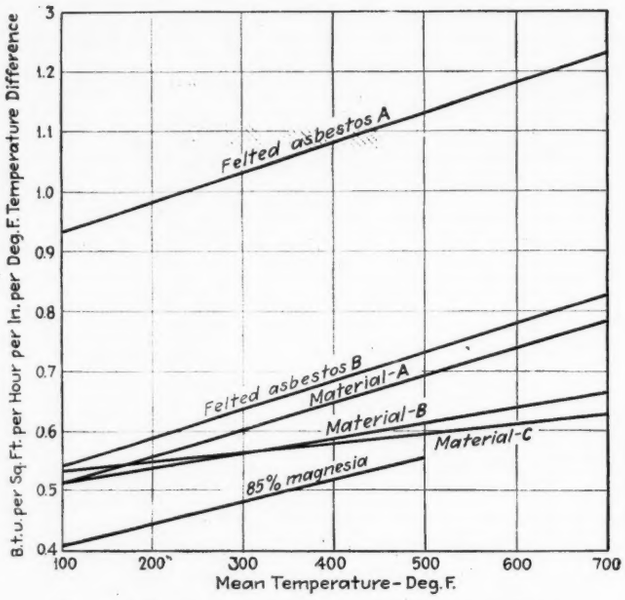


Fig. 1—Thermal conductivity of high-temperature insulations compared with 85 per cent magnesia

materials resistant to high temperatures were developed. Felted asbestos, however, had the advantage of high mechanical strength; and, for the insulation of flat and curved surfaces, it could be molded in large size sheets, which under certain circumstances is a desirable feature because of the minimizing of joints between adjacent blocks.

The felted-fiber blocks were usually made of Canadian asbestos, which matted quite compactly, resulting in a product that weighed about 34.2 lb. per cubic foot for material $1\frac{1}{2}$ in. thick.

The structure of felted-fiber insulation has, within the past two years, been markedly changed. Brown African asbestos fiber, which is long and fluffy, is used instead of the all-Canadian fiber. This improved structure results in a product of superior insulating value and considerably lighter weight. The improved felted asbestos fiber weighs about 19 lb. per cubic foot. An idea of the improvement in insulating value is gained by referring to conductivity curve *B* for felted brown African asbestos as compared with curve *A* for felted Canadian asbestos in Fig. 1.

In addition to the felted asbestos block insulation there are two other main classes of high-temperature insulation available at present: (1) high-temperature insulation in which diatomaceous earth is the base, and (2) high-temperature insulation in which no diatomaceous earth is incorporated.

Diatomaceous, or infusorial, earth, a relatively pure porous form of silica, seems to possess the excellent

combination of insulating value and high-temperature resistance. Unfortunately, this material lacks cohesiveness. To mold it into suitable pipe-covering forms having reasonable mechanical strength it is necessary to use a binder. As in the case of molded asbestos insulation, the bonding material increases the rate of heat transmission and largely nullifies the natural value of the fine, porous earth.

The conductivity of one specimen made of diatomaceous earth, having reasonable strength but lacking in insulating value, is shown by the curve for material *A*, Fig. 1. Another such product, material *B*, also shown in Fig. 1, has good insulating value but lacks strength.

A decided brittleness, or easy breakage under jars and blows, is a noticeable characteristic of diatomaceous earth insulations.

Only within the past two years has research developed high-temperature insulations that contain no diatomaceous earth. The conductivity characteristics of one of these new developments are shown by the curve in Fig. 1 designated material *C*.

The relative flatness of the material *C* curve indicates that at the high temperatures where this type of insulation is intended for use its insulating value decreases less rapidly than that of other high-temperature materials.

In the high-temperature range, radiation plays a large part in the transmission of heat. Greater resistance to the transmission of radiant heat is considered to be indicated by the relative flatness of conductivity curves. If this information is correct, material *C* would seem to have greater resistance to the flow of radiations than has either material *A* or *B*.

Fig. 1 also shows the conductivity of 85 per cent magnesia for comparative purposes.

Since high-temperature insulations cannot be made with as low conductivity as those used for lower temperatures, and are more costly, it is evident that only a sufficient thickness should be used as a first layer to reduce the temperature to within the safe limits at which 85 per cent magnesia or other insulating material can be used as an outer layer. In the case of the poorer high-temperature insulators having relatively high rates of transmission compared with the outer layer, this thickness must be disproportionately large. In the case of material *C*, with a heat transmission closely approaching that of 85 per cent magnesia, a minimum thickness is required.

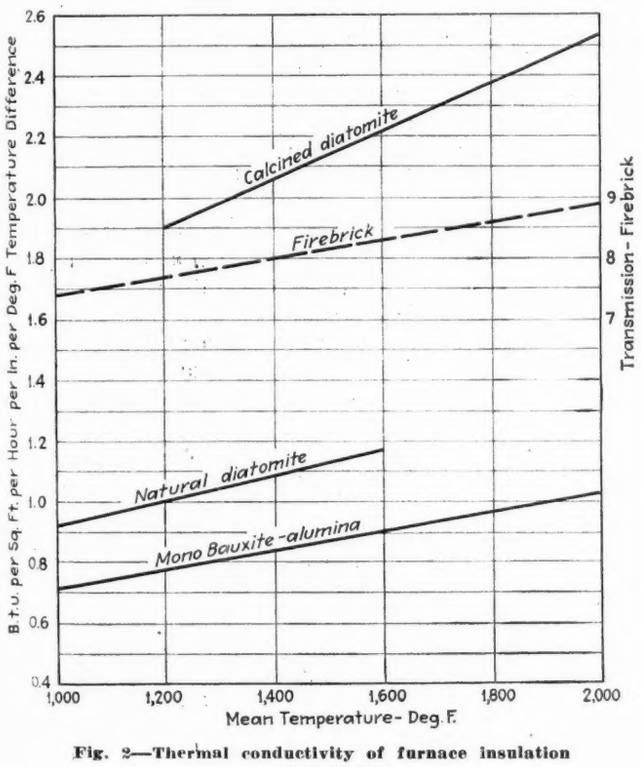


Fig. 2—Thermal conductivity of furnace insulation and firebrick

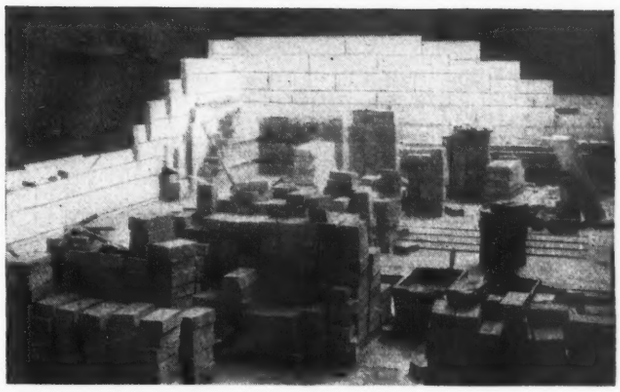


Fig. 3—Applying mono-bauxite (alumina) insulation to furnace. Note the large dimensions of the insulating blocks

Mechanical Features

As in the case of low-temperature molded insulations, structural strength of high-temperature materials is of considerable importance. The same reasoning in regard to types of mechanical tests applies to high-temperature insulation, and the transverse test should not be relied upon to furnish a true picture of the expected durability of the insulation. Impact resistance in the high-temperature range is of paramount importance.

In view of the fact that materials *B* and *C* are the outstanding forms of insulation in the high-temperature field, the following test results are presented for comparative purposes and to indicate the factors that influence the intelligent purchasing of insulating materials:

Results of Mechanical Tests

	Transverse Strength, Lb.		
	As Manufactured	After Heating in Electric Oven for 24 Hr. at 750 Deg. F.	1,000 Deg. F.
Material *B*	48	40	30
Material *C*	80	49	22

Blocks 1½ in. thick and 6 in. wide supported on 10 in. centers with load applied at center.

	Impact Resistance, Ft.-Lb.		
	As Manufactured	After Heating in Electric Oven for 24 Hr. at 750 Deg. F.	1,200 Deg. F.
Material *B*	63	37	10
Material *C*	117	97	27

	Permanent Lineal Heat Shrinkage	
	750 Deg. F.	1,200 Deg. F.
	Per Cent	
Material *B*	0.5	1.0
Material *C*	0.6	0.95

Data result from subjecting the insulation to the temperature given, for 24 hr., in an electric furnace.

When considering tests performed on samples subjected to soaking in an electric furnace, where the entire block is subjected to the intense heat, it must be recognized that the most severe conditions are being imposed on the material. In practice only the inner sur-

face of the block or section is subjected to the high temperature. Therefore the average lineal shrinkage will be less than that indicated by electric furnace tests. This point should be borne in mind in considering all test data.

In addition to the high-temperature insulations discussed so far, there is a product on the market which is made from stone or slag fluxed and then blown into very fine filaments which are matted into a spongy mass. This material has resistance to high temperatures, but its consistency is such that some mechanical means must be employed either to bond or support the fibrous structure.

Insulation of Furnace Walls

The highest temperature at which the insulations considered so far should be used for reasonably satisfactory service is about 1,400 degrees. Electric ovens, boiler combustion chambers, glass lehrs, regenerators and such equipment, although lined with firebrick, need insulation either for heat conservation, temperature control, comfort of working quarters or a combination of these objectives. Insulation for such purposes must generally stand temperature higher than 1,400 degrees.

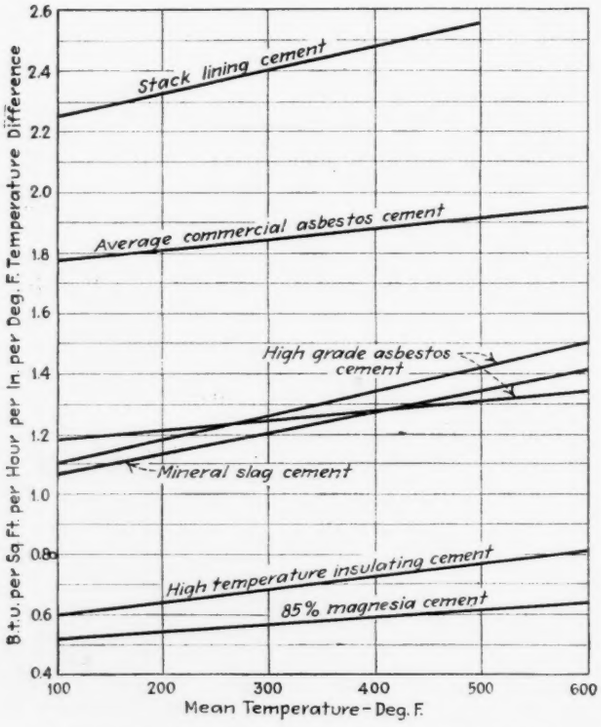


Fig. 4—Thermal conductivity of insulating cements

This requirement has been met by a well-known diatomaceous earth material that is cut directly from the deposit and formed into standard brick sizes. In its natural state this material is suitable for temperatures up to 1,600 deg. F. To meet higher temperature requirements, this same type of material is burned or calcined and formed into standard-size bricks suitable for temperatures between 1,600 and 1,900 degrees.

Recently a newly developed high-temperature insulation suitable for temperatures between 1,000 and 2,000 deg. F. has been placed upon the market. The base of this new material is alumina, commonly known as monobauxite, which is capable of standing extremely high temperatures. The manufacture of this new material is a departure from previous procedure for boiler wall insulation in that the blocks are furnished as large as 9 in. wide, 36 in. long and $2\frac{1}{2}$ in. thick, in addition to smaller sizes. Larger blocks in furnace wall construction improve the thermal efficiency of the installation, because of the elimination of a great number of joints between the blocks as found in the old type of brick insulation, and in addition cut down the installation cost and shorten the time of erection.

The heat-resisting characteristics, mechanical strength and insulating properties of this new material, made from alumina and combined with asbestos fiber and suitable clays, are extremely good. Fig. 2 indicates the relative insulating characteristics of materials suitable for insulating furnace walls, regenerators, etc.

Insulating Cements

Insulating cements, of which 85 per cent magnesia cement is an example, are intended for pointing up joints between pieces of insulation, and to fill in cracks or depressions in the material. Plastic cement is used generally for the complete insulation of small-size irregular surfaces, pipe fittings, etc. Wherever possible, however, standard covering and blocks of insulation should be used in preference to cement.

It seems to be a characteristic of high-grade insulating cements to shrink and crack upon drying. This is due to the water added to the dry material to make it workable. All cracks should be filled up before additional layers of cement are applied. Insulating cements, such as 85 per cent magnesia, are made from the same materials as molded covering and blocks, and the insulating value of the cement is practically the same as that of the molded material. The composition of a cement should be the same as that of the molded insulation with which it is used; for instance, 85 per cent magnesia cement should be used with 85 per cent magnesia insulation and the laminated type of covering, and high-temperature cement should be used with high-temperature insulation. This procedure assures suitable insulation and satisfactory installation.

Asbestos cements are intended as a finishing coat for various types of insulation. They are not designed primarily from an insulating standpoint. Asbestos cements usually contain substantial quantities of clay, to provide plasticity, sticking ability and smooth finishing properties.

In the past stress has been laid on long-fibered asbestos cements, but from the discussion which has gone before it may be obvious that long fiber does not necessarily result in insulating efficiency.

Fig. 4 shows the wide variation in insulating value of asbestos cements, which, when compared with Fig. 1, shows the relatively poor value of such materials from a heat-saving point of view.

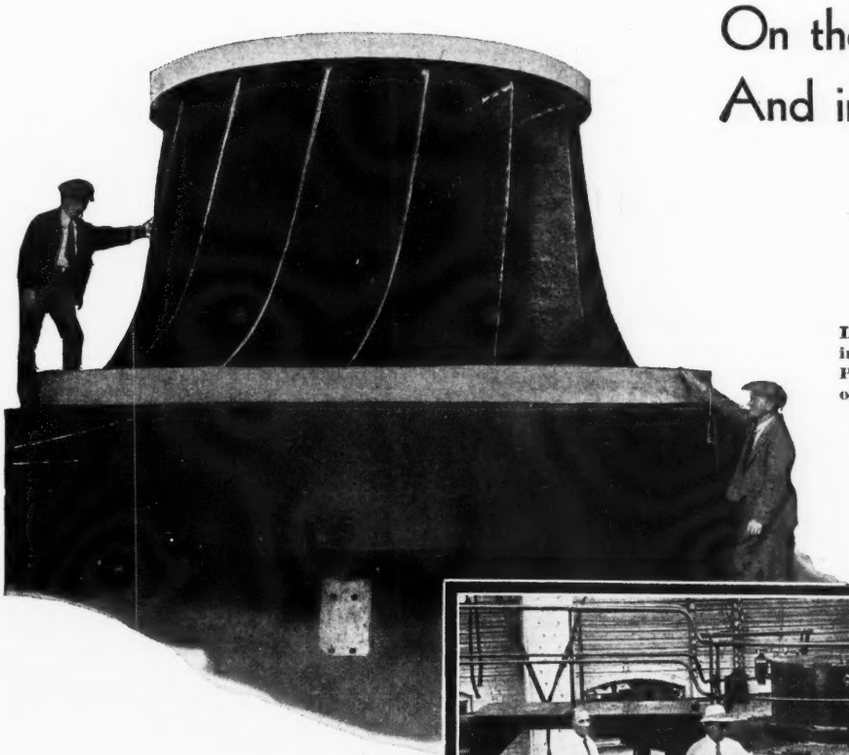
In analyzing the relative value and cost of different cements, the covering capacity is of utmost importance. The covering capacity is the number of square feet covered by 100 lb. of cement applied 1 in. thick. The cost per square foot of cement should be computed and used as the basis of comparison.

The selection of cement to meet a certain class of service should be made in the light of its sticking properties, low shrinkage, easy workability, and finishing qualities, in addition to the cost per square foot of material.

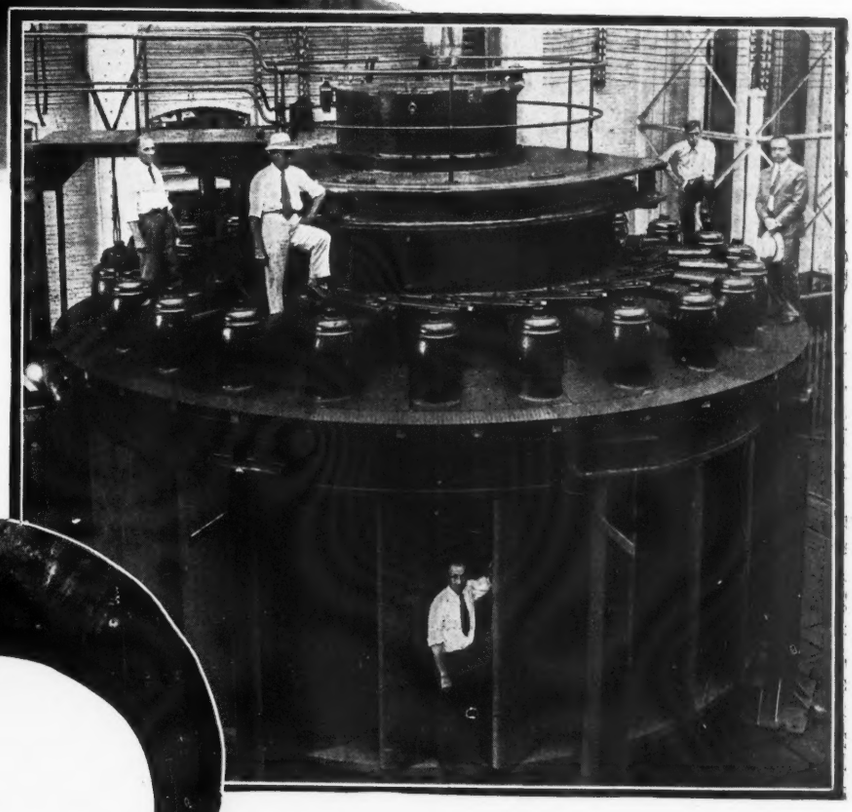
[The next article on insulation will deal with outdoor and underground insulation—Editor.]

HYDRO GIANTS

On the Hudson River And in Newfoundland



Left—Runner for 57,000-hp. unit installed in the Spier Falls plant of the New York Power & Light Corporation. This runner operates under an 81-ft. head at 81.8 r.p.m. and weighs 140 tons



Right—Assembly of the wicket gates and operating mechanism for the Spier Falls unit. The plate-steel spiral casing for this unit measures 83 ft. over-all. During low water the total flow of the Hudson River will pass through this wheel

Left—Plate-steel spiral casing for one of two 32,000-hp. units built for the Deer Lake Development of the International Power & Paper Company in Newfoundland. The wheel installed in this casing showed a record efficiency of over 94.5 per cent on field test

Photos courtesy of Newport News Shipbuilding & Dry Dock Co.

Peak-Load Capacity at High Efficiency From Bleeder Turbines

By A. G. CHRISTIE and WARREN VIESSMAN
Professor *Graduate Student*
Johns Hopkins University

An abstract of a paper presented before the metropolitan section of the A.S.M.E. on Jan. 8. The authors show that peak-load capacity can be obtained from bleeder turbines at low cost and high efficiency by cutting out bleeder heaters and supplying the boilers with hot feed water from storage during peaks

CENTRAL STATION management has always been confronted with the problem of large plant investments to meet maximum demands and with low use-factors due to peak loads. The problem of supplying peak-load capacity at minimum cost has been attacked more or less successfully and solved by various methods, such as: maintaining older uneconomical plants for peak service, hydraulic storage, installing diesel engines, and Ruths steam accumulators.

In the United States, modern developments in steam-power plants have led to the general acceptance of turbine-generator units of the bleeder type, from which steam is extracted at several points and utilized for heating the feed water. High-temperature feed water is obtained economically in this manner, but at the same time turbine-generator capacity is reduced below that possible without bleeding and with the same steam flow entering the turbine. This suggests the idea that increased turbine-generator output might be obtained by shutting off the bleeder heaters and permitting the total steam flow to pass through the turbine to the condenser. That such power is available and can be obtained has been demonstrated by trials made at Gould Street station, Baltimore; Long Beach station, Los Angeles; and Lakeside station, Milwaukee, where increased capacity was secured by cutting off certain of the bleeder heaters. Hence manipulation of the bleeder heaters can be considered as an additional method of providing peak-load capacity.

Other problems are introduced by shutting off the bleeder heaters. Colder feed water must be supplied to the boilers, and when all heaters are cut off the feed will be at condensate temperature. This increases the heat that must be supplied by the boiler, and therefore increases the rate of firing. Cold feed water is not good practice, as it increases stresses in feed lines and in boiler shells. However, if there is no objection to cold feed water and to overloading the boiler and furnace, substantial increases in peak-load capacity can be obtained by shutting off the bleeder heaters.

These considerations indicate that any method which could be developed to discontinue bleeder feed-water heating at the time of peak loads, without at the same time necessitating the use of cold feed water for boilers, deserves careful consideration as a desirable means for carrying peak loads of relatively short duration.

Diagrammatic arrangement of such plant equipment is shown in Fig. 1. Full capacity of the turbine-generator

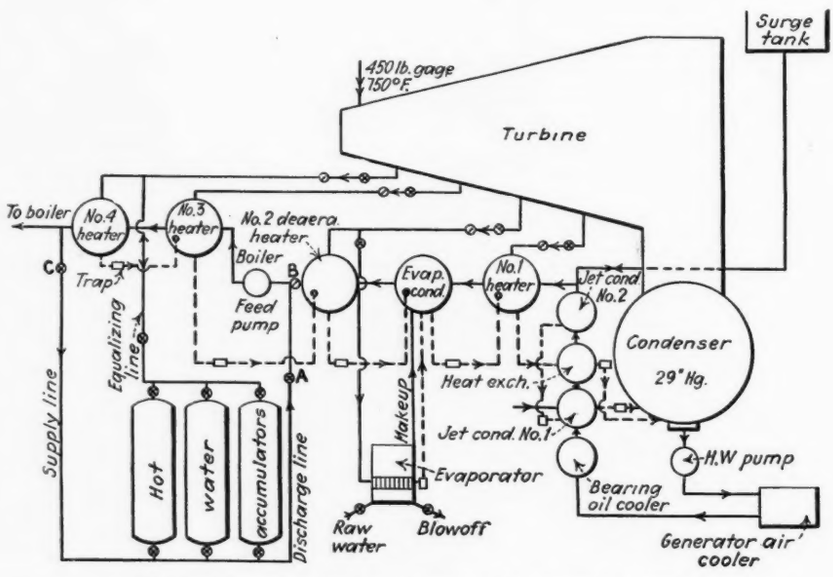


Fig. 1—Diagrammatical arrangement of proposed system

set was assumed to be 62,040 kw., when operating at 450 lb. gage steam pressure, 750 deg. F. steam temperature, 29 in. of vacuum, with boiler feed water heated to 386.8 deg. F. leaving the last bleeder heater, and when 673,000 lb. of steam per hour is entering the throttle. Hot-water accumulators, surge tanks of increased capacity and some additional valves and piping form the only equipment added to this standard layout to enable it to carry peak loads with all bleeder heaters out of service and the boilers furnished with hot feed water from storage.

During periods of heavy load in excess of nominal maximum capacity when bleeding, the extraction of steam to the four heaters is discontinued, and the condensate, after passing through the generator air cooler, bearing oil cooler, and the jet condensers, is stored in the surge tank. Feed water for the boilers at about 365 deg. F. is furnished from the hot-water accumulators. A small amount of steam is automatically supplied from No. 4 bleeder heater to the hot-water accumulators to compensate for displacement of the hot water drawn off by the boiler feed pump and to maintain pressure in the accumulators. These accumulator tanks should be normally full of water and in continuous contact with steam from this fourth bleeder point when heavy loads are expected, so that the water in the accumulators has approximately the same temperature as the steam from the fourth bleeder point.

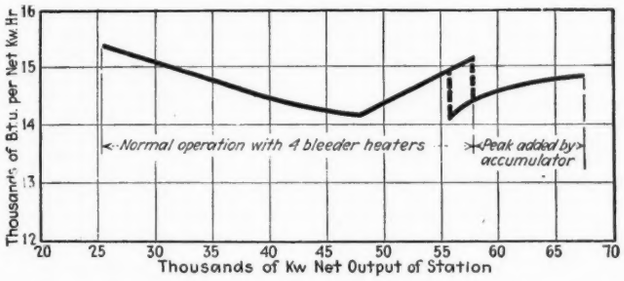


Fig. 2—Effect of feed accumulators on station performance

To demonstrate the simplicity and efficiency of the proposed system, assume that the accumulators are filled with hot water and that the load, with all four heaters in operation, is approaching the maximum capacity of the turbine. The discharge valve *A* from the accumulators to the boiler feed pump suction is opened. The water pressure in the accumulators exceeds that from the condensate pump at the inlet to the boiler feed pump and causes the check valve *B* in the regular feed line to close automatically. The feed water from the accumulators leaves the boiler feed pump and passes through the third and fourth bleeder heaters at the temperature at which it normally leaves the fourth heater. Hence no steam is drawn from the turbine shell to heat the feed in these two heaters, and they therefore act as though they were cut off from the turbine. Steam normally withdrawn at these two points now passes down the turbine to the condenser, increasing the energy available to do work in the turbine.

When check valve *B* closes, the flow from the condensate pump can no longer pass through the first and second bleeder heaters, but passes directly to the surge tank. With no water flowing through these two heaters, no steam is withdrawn at the corresponding two bleeder points, and the two heaters are virtually cut off from the turbine. The steam that would normally be bled at these two points now passes to the condenser and adds further available energy to the turbine. The increase in output is substantial even after allowance is made for greater leaving losses and for decrease in condenser vacuum with the flow of cooling water maintained constant.

During periods of load below full capacity, bled steam to the four heaters is utilized to heat not only the condensate from the condenser at that load, but also a portion of the excess condensate which was stored in the surge tank during the peak-load period. This excess supply of hot water above boiler feed requirements is utilized in charging or refilling the hot-water accumulators through valve *C*.

Heat-balance calculations have been made for the plant assumed in the diagram, Fig. 1, with operating conditions of 450 lb. gage, 750 deg. F. and 29 in. vacuum, and 386.8 deg. F. feed water temperature from heaters, at maximum load. Air preheating to 400 deg. F., with forced- and induced-draft fans, was assumed, with pulverized coal for a plant of three boilers each of 23,000 sq.ft. of heating surface operating at 84 per cent efficiency when delivering the maximum steam required. Power requirements for all of the various auxiliaries were estimated, giving a net station output at maximum capacity of 57,630 kw., and 48,200 kw. at most economical load. With the use of hot-water accumulators the net station output, allowing for auxiliaries, could be raised from 57,630 kw. to 67,825 kw., an increase in capacity of 10,195 kw., or 17.7 per cent. Table I gives the various capacities and station heat rates for normal operation without accumulators and for operation on peak loads with accumulators designed for two-hour peaks. The accumulator was assumed to be recharged during an eight-hour period.

Two performance figures in B.t.u. per kilowatt-hour are given for accumulator discharge conditions. The first figure represents the actual performance during the peak-load period when the boilers receive stored hot water from the accumulators. The second figure, "compensated station performance for accumulators discharging B.t.u. per kilowatt-hour," indicates the station heat rate during peak load with the accumulators discharging, but with calculated allowances included for the extra heat required from added bled steam to heat the water on its way from the surge tank to the accumulators at other times and at loads less than maximum capacity during the charging periods of the accumulators. These data are shown graphically in Fig. 2, which presents the performance curve of the station for normal operation, and for operation with the accumulators discharging on peak loads.

TABLE I—STATION HEAT CONSUMPTION

Normal Operation				
Net station output, kw	57,630	48,200	36,900	25,060
Over-all station performance, B.t.u. per kw.-hr.	15,130	14,150	14,750	15,330
Accumulator Discharge				
Net station output, kw	67,825	61,655	57,645	55,800
Over-all station performance with accumulators discharging B.t.u. per kw.-hr	12,900	12,770	12,470	12,210
Compensated station performance for accumulators discharging B.t.u. per kw.-hr	14,875	14,695	14,385	14,120

Total duration of the peak load that may be carried is governed by the storage capacity of the accumulators. For a two-hour peak three accumulators of 8,480 cu.ft. capacity each have been provided for this plant. They would be 12 ft. in diameter, with hemispherical ends, and 80 ft. long. They are of sufficient size to store the 1,366,000 lb. of feed water required for operation of the plant at full peak-load capacity for two hours. These

accumulators were estimated for installation out of doors, with 5 in. of insulation and with an outside sheet-metal covering. Increased surge tank capacity of approximately 22,000 cu.ft. was assumed to be provided within the plant.

Plant Costs

To provide capacity for the 67,825-kw. peak continuously for a period of two hours an estimated investment as shown in Table II would be required. With an increase in capacity of 10,195 kw. the plant cost is $24.36 per kilowatt-hour of added peak capacity.

TABLE II—ADDED PLANT COST WITH ACCUMULATORS

Three accumulators, each of 8,480 cu.ft. capacity	$110,000
Foundations for accumulators	15,000
Insulation for accumulators	10,000
Additional valves, piping and pipe covering	15,000
Cost of enlarged surge tank	16,000
Cost of 10,000 kw. of increased generator capacity and cooling system at $5 per kw.	50,000
Engineering and overhead expenses at 15 per cent	32,400
Total	$248,400

Calculations have also been made for a plant of similar capacity and arrangement by assuming the same maximum throttle flow of steam, but with five bleeder heaters producing a final feed-water temperature of 403 deg. F., instead of 386.8 deg. F., at maximum load. With the addition of the fifth heater, 56,595 kw. net station output could be obtained as the maximum normal loading with a heat rate of 15,200 B.t.u. With the accumulator on discharge, a net station load of 68,620 kw. could be carried at the time of peak load with a compensated heat expenditure of 14,820 B.t.u. Therefore, with the fifth heater, an increase of 12,025 kw., or 21.25 per cent, in net station capacity may be obtained. Calculations were also made to determine the per cent increase in peak-load capacity that could be obtained with a similar plant if it were provided with only three bleeder heaters. The effect of a number of heaters on the peak load to be obtained above the maximum capacity of the normal plant is shown in Fig. 3.

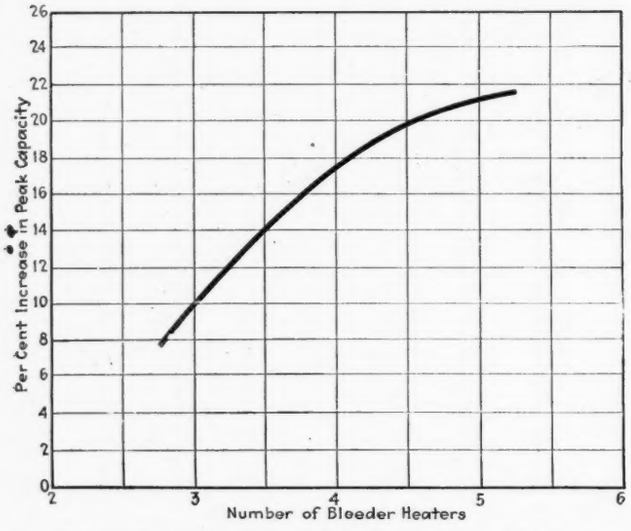


Fig. 3—Effect of number of bleeder heaters on peak load obtainable with accumulator

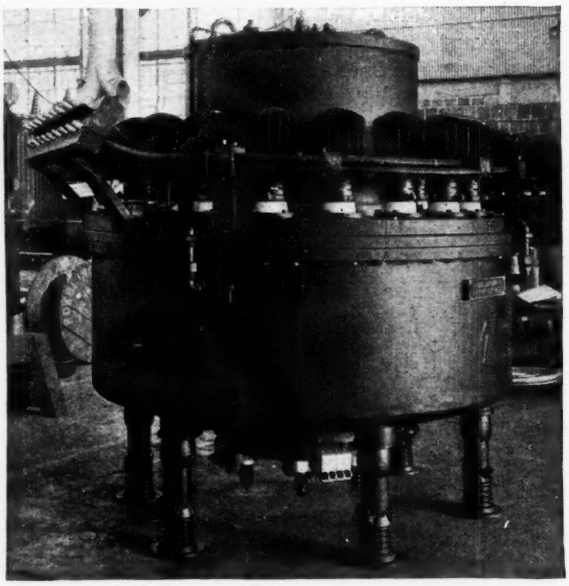
Other Systems With Water Storage

The scheme of hot water storage with four bleeder heaters requires that the accumulators be built for a steam pressure of 215 lb. per square inch gage, to store hot water at 365 deg. F. The cost of accumulators may be reduced if this storage can be provided at a lower pressure. This can be done, provided boilers and furnaces can be overloaded beyond the capacity required with all bleeder heaters in service, by placing the accumulators so they are charged with hot water heated in either the second or third heaters. The gain in peak-load capacity is substantially the same, that is, 17.5 per cent, whether the accumulators are placed after No. 4, No. 3 or No. 2 bleeder heaters. The boilers and furnaces, however, operate at the same ratings with or without accumulators in service when placed at No. 4 bleeder heater, but at increased ratings in the other positions.

If boilers can be operated at high ratings when fed with water colder than normal, peak-load capacity can be secured by simply cutting off the bleeder heaters. A considerable gain in unit capacity may be secured by cutting off No. 4 bleeder heater only. Computations indicate that the peak-load capacity will be increased about 6 per cent by this method, while the boiler rating and fuel consumption will be increased about 7 per cent. If both No. 4 and No. 3 bleeder heaters are cut off, the peak-load capacity will be increased about 11.8 per cent, with an increase in boiler rating of approximately 14 per cent.

These methods give substantial increases in peak-load capacity at a small sacrifice in station economy. The interesting point is that their use involves no additional cost provided the generator can carry the added load. Additional cooling in the generator would not be expensive. Such methods can be used advantageously at the time of peak load in almost any modern plant with three or more bleeder heaters. Utilization of hot water storage in accumulators for peak loads requires a low investment, is simple and reliable in operation and is economical in fuel consumption.

Mercury-Arc Rectifier For High Rating



This American Brown Boveri 18-anode rectifier installed by the Long Island Railroad has a normal rating of 4,600 amp. at 650 volts, or 3,000 kw. Its overload ratings are 6,900 amp. for 2 hr.; 13,800 amp. for 1 min.; and 15,000 amp. 20 seconds

Submerged Grinder Rolls Prevent Overheating*

By R. A. FORESMAN

Chief Engineer, Stoker Dept.
Westinghouse Elec. & Mfg. Co.

EARLY IN 1928 Westinghouse placed in service the first link-grate stoker. It differed radically from the conventional type of underfeed stoker by using, in connection with the conventional underfeed section at the top of the stoker, a comparatively large overfeed section at the bottom, the latter being a substantial portion of the total grate area. The clinker-grinder pit also differed from the conventional pit, as an immovable solid brick or refractory front wall was substituted for the sectional cast-iron wall, with movable aprons.

When it was decided to employ this construction for the front wall, it was also decided to use it for both the front and rear clinker-grinder pit walls where a refractory bridge wall was used and for both clinker-grinder pit walls where a double stoker was employed.

Almost immediately following the appearance of this type of clinker-grinder pit, another departure was decided upon. This consists of filling the ashpit up to and over the clinker grinder rolls with water. Submerged in this manner, the rolls grind the ash into the water-filled pit beneath.

In order to explain what considerations led to this change it will be necessary to review briefly the history of the development and use of the clinker grinder.

In the initial stages of the development of the clinker grinder, the pit, into which the stoker discharged its refuse before it was ground out into the ashpit beneath, was of a design and construction entirely different from the present pit. This earlier pit was very shallow. The walls, constructed of cast iron, were little more than downward extensions of the lower end of the stoker and bridge wall, making the pit wide at the top and narrow at the bottom. The rolls were much the same as are used today. The ashpit below the rolls was usually small, and ash removal was difficult.

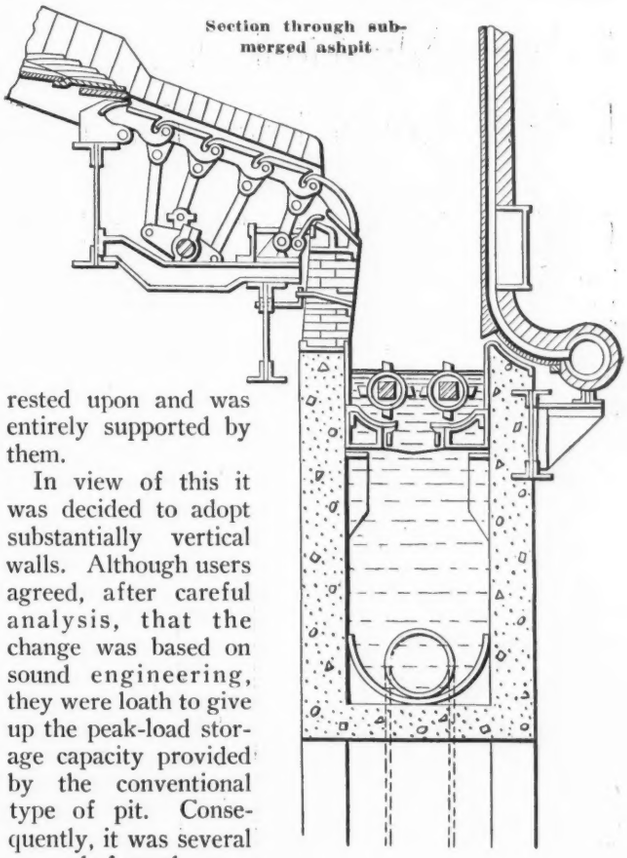
The earlier installations gave trouble under service conditions, and were subject to high maintenance on the rolls and the cast-iron elements forming the walls. One of the factors contributing to this was the type of ashpit used. Frequently, during peak loads, while the rolls were grinding out hot material, the ashpits would become filled because of their limited capacity, and the rolls were damaged by being surrounded with hot material. Furthermore, the gas forming and burning in the pit found less resistance downward to the ashpit than upward through the fuel bed to the furnace. This resulted from the ashpit not being of airtight construction.

Another troublesome condition in the earlier design was the difficulty encountered in grinding out the refuse. It could not be ground uniformly and, regardless of the coal used, large and practically unmanageable clinkers formed. Sometimes these clinkers could be removed only by putting the boiler on a low bank or taking it out of service altogether.

The problem was met by increasing the depth of the clinker grinder pit. However, the walls were left inclined much as before, increasing the width at the top. The size of the ashpit was also increased.

For a number of years this procedure was accepted practice, but about 1920, Westinghouse engineers became convinced that:

1. The sloping walls formed natural skew-backs for supporting arches formed by clinker.
2. The larger clinkers were forming such arches immediately above and out of reach of the teeth of the grinder rolls.
3. These arches supported the refuse above them, and as long as this condition prevailed the grinder rolls were ineffective.
4. The grinder rolls were capable of grinding out any clinker, regardless of its size, providing the clinker rested upon and was entirely supported by them.



Section through submerged ashpit

In view of this it was decided to adopt substantially vertical walls. Although users agreed, after careful analysis, that the change was based on sound engineering, they were loath to give up the peak-load storage capacity provided by the conventional type of pit. Consequently, it was several years before the new design was accepted, and even then this was hastened by the water-cooled bridge wall coming into general use.

It was only another step to submerge the rolls by filling the ashpit with water. Specifically, three new advantages were gained by this last step.

1. Submerging the rolls prevents overheating, with consequent damage.
2. A certain amount of disintegration of the clinker, as a result of coming in contact with the water before reaching the grinder rolls, makes it easier to grind out.
3. An effective air seal for the clinker-grinder pit is provided by the normal water level above the rolls, thereby assuring that the air delivered to the pit can be controlled and utilized for burning out the combustible.

Although these immediate results were desirable, they were not the main considerations that led to the adoption of the submerged rolls and water-filled ashpit.

*Some months ago Mr. Foresman in an illustrated talk on stokers before the metropolitan section of the A.S.M.E. showed a picture of a submerged clinker-grinder pit his company had developed. It was believed that engineers would be interested in knowing more about this type of pit, and the author was requested by *Power* to prepare an article giving the story of its development.—EDITOR.

Their adoption was based on a careful analysis of the entire ash-storage and removal problem.

The large ash-storage pit below the unit was necessary not only to provide a capacity which would assure that the pits need be cleaned out only on the day shift, but also for reserve capacity in the event of a failure of the conveying system. As the depth of the ashpit increased, basement heights increased, making necessary a great deal of space that seldom could be utilized economically. Also there were times when gas, smoke, steam and water were present in the basement in large quantities. These gases and vapors were of a highly corrosive nature. In the case of failure of the ash-disposal system, the ash and water also contributed to making the boiler room basement a poor place either for equipment or for individuals to work in.

Except for increasing the ash storage below the boiler unit as the quantity of coal burned increased, little or no change had been made in ash disposal systems until within the last few years, when ash sluicing and ash pumping came into general use.

It was obvious that there would be no reason for large ash-storage pits below the boiler units if there could be provided a dependable ash-disposal system which removed the ash as fast as the clinker grinder produced it. It became equally obvious that the place to store refuse material, which must be disposed of as such, was on the outside of a plant.

With these things in mind and along with the desirability of using water to quench the ash and clinker as soon as it was ready to be disposed of, and of using water as a conveying means for storing the ash on the outside of the boiler room, it was decided to adopt the submerged rolls and water-filled ashpit.

▼ ▼ ▼

Bids on Municipal Diesels Indicate Lower Price Trend

ON NOV. 24, 1930, bids were opened by W. A. Fuller Company, consulting engineers, St. Louis, Mo., for two diesel engines, direct-connected generators, exciters, all piping and auxiliaries for a municipal plant for Sikeston, Mo.

The award for the power plant equipped went to Fairbanks Morse & Company, on their bid, for two 600-hp. units, of $61,267.

The bids cover the machinery necessary to the plant, but do not include certain accessories, or the building. Contracts for these were let for the following sums: Building, foundations, oil storage tank and cooling tower, $15,655; water softener, $1,100; switchboard, $4,200, and station wiring, $1,945. This makes a total power plant cost of $88,375, including an engineering fee of 5 per cent, or $110 per kilowatt.

In examining these bids it will be seen that there are wide differences in the weights per horsepower of the several engines. If one calculates the price per pound upon the total bids and the weights of the engine and flywheel, the values run from 94 to 37 cents per pound, with the higher price per pound usually applying to the high-speed units.

Diesel Engine Bids, Sikeston, Mo., Municipal Power Plant

BIDDER	A	B	B	C	D	D	E	E	F	G	H	H
Price complete	$72,220	$85,627		$67,722	$61,267	$67,900	$74,220	$62,944	$82,929	$87,727	$74,248	$68,955
Rated horsepower and kilowatt, each engine	600–400	640–400		625–428	600–410	700–480	625–415	640–400	660–450	600–400	680–465	600–410
Deduct for direct-conn. exciters	$680				$1,400		$1,500	$1,600			$1,013	$1,655
Diameter of cylinders, in.	17	13¼		17½	16	16	17¼	15	17	14	16¼	13
Length of stroke, in.	25	18		25	20	20	24	18	23	18	23	17
Piston speed (ft. per min.)	937	900		937	857	1,000	960	900	985	900	985.2	1,020
R.p.m.	225	300		225	257	300	240	300	257	300	257	360
Cycle	4	4		4	2	2	4	4	2	4	4	4
Air or solid-injection	Air	Solid		Air	Solid	Airless	Solid	Solid	Air	Solid	Air	Air
Number of cylinders	5	8		5	4	4	5	8	3	8	6	8
Weight of engine, lb.	170,000	128,000		153,000	110,700	113,000	143,000	101,600	130,000	81,500	148,500	80,000
Weight per horsepower	283	200		245	184	161	229	159	197	136	218	133
Fuel oil guarantee: lb. per b.hp. hr.:												
Full load	0.41	0.38		0.42	0.41	0.41	0.43	0.44	0.44	0.42	0.43	0.45
¾ load	0.425	0.39		0.45	0.43	0.43	0.43	0.44	0.45	0.43	0.45	0.47
½ load	0.475	0.45		0.49	0.46	0.46	0.46	0.48	0.48		0.50	0.53
¼ load	0.625	0.60		0.66					0.65		0.68	0.73
Generator efficiency, per cent:												
Full load	93.3	92.0		93.0	93.0	94.0	92.8		93.4	93.2	93.4	93.5
¾ load	93.0	90.0		92.6	92.8	93.9	92.6		93.1	93.0	93.1	93.3
½ load	92.1	88.0		90.5	92.1	93.2	91.6		92.1	92.0	92.1	92.3
¼ load	87.0										91.1	91.3
Mean effective pressure	74.0	90.0		73.2	57.3	58.0	71.2		65.0	71.5	73.25	73.12
Weight of flywheel, lb.	23,000	7,000		21,700	9,200	9,200	16,000	6,700	12,250	9,000	12,147	5,360
ALTERNATE PROPOSAL												
Price	$63,133	$72,219	$69,875		$48,500	$56,000	$64,072	$55,687		$71,429	$67,612	$58,692
Rated horsepower and kilowatt	480–320	525–350	480–300		425–288	525–360	500–340	480–325		450–300	565–385	450–300
Diameter of cylinders, in.	17	14	13¼		12	14	17½	15		14	16¼	13
Length of stroke, in.	25	18	18		15	17	24	18		18	23	17
Piston speed (ft. per min.)	937	900	900		900	850	960			900	985.2	1,020
R.p.m.	225	300	300		360	300	240	240		300	257	360
Cycle	4	4	4		2	2	4	4		4	4	4
Air or solid-injection	Air	Solid	Solid		Airless	Airless	Solid	Solid		Solid	Air	Air
Number of cylinders	4	6	6		5	5	4	6		6	5	6
Weight of engine (without generator)	140,000	110,000	96,000		67,000	81,000	119,000	81,600		70,000	132,500	64,000
Weight per horsepower	290	209	200		158	154	238	170		155	234	142
Fuel oil guarantee:												
Full load	0.41	0.38	0.38		0.42	0.42	0.43	0.44		0.42	0.43	0.45
¾ load	0.425	0.39	0.39		0.45	0.45	0.43	0.44		0.43	0.45	0.47
½ oad	0.475	0.45	0.45		0.49	0.49	0.46	0.48			0.50	0.53
¼ load	0.625	0.60	0.60								0.68	0.73
Generator efficiency, per cent:												
Full load	92.8	92.0	92.0		92.6	93.8	92.5			92.6	93.0	93.1
¾ load	92.6	90.0	90.0		92.6	93.5	92.3			92.4	92.8	92.4
½ load	91.6	88.0	88.0		92.1	92.6	91.3			91.4	91.8	90.6
¼ load	86.5										90.8	88.4
Mean effective pressure	74.0	90.0	90.0		55.1	53.2	71.2			71.5	73.25	73.12
Weight of flywheel, lb.	23,000	7,000	7,000		4,500	3,900	16,000	6,700		8,700	23,590	5,360

...RIGHT OUT OF THE PLANT...

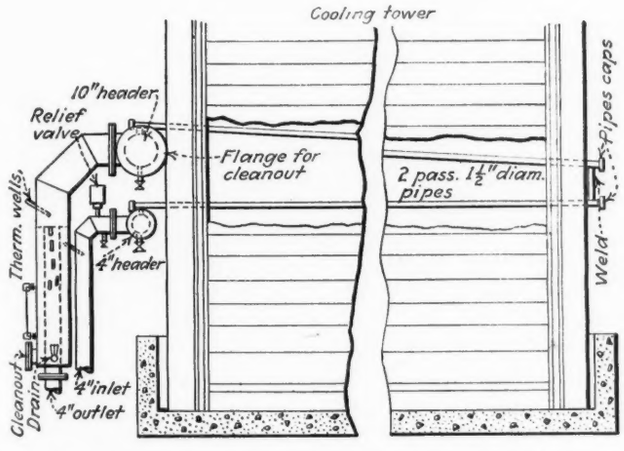
Gas Cooling System for Two-Stage Compressor

IN COOLING gas having high sulphur and other foreign matter content, between the low- and high-pressure sides of a compressor, the foreign matter is often drawn into the high-pressure cylinder with serious results to the piston rings and valves. To remedy this, the following idea was adopted. A cooling section was made up from twelve $1\frac{1}{2}$-in.-diameter pipes threaded at both ends. At one end they were connected together by welding a cross piece of pipe as shown, making a return bend with open ends, the ends being closed with pipe caps.

The intake end of each loop is welded with a down drop into a 4-in. header with flanges at the end, also a drain plug. The outlet end of each loop is welded with a small down drop into a 10-in. header, which is also fitted with flanges and a drain. By use of the pipe caps, steam can be injected into the cooling sections, or a rod can be pushed through to clean the tubes out. In doing this the débris falls into the 10-in. header and can be removed through the flanged openings at either end.

Owing to the cooling, there is a possibility of water being thrown down. To take care of that the gas leaves the 10-in. header through a 10-in. pipe about 6 ft. long equipped with a drain and clean-out flanges.

As the main suction to the high-pressure compressor is 4 in., this line is brought up inside the 10-in., as shown, to a point about 3 ft. from the bottom. The



Arrangement of cooling system used with two-stage gas compressor

4-in. line is perforated with holes to equal the area of a 4-in. pipe, and a deflecting plate is fitted to the top. The gas then comes in through the lower 4-in. header, passes through the cooling section and out into the 10-in. header and downtake or "bootleg." Water or other moisture thrown down in the cooling is deposited in the bottom of the 10-in. vertical pipe, while the gas flows through the perforations to the compressor suction. There is a drain at the bottom that is opened at intervals, also a gage glass to indicate water, etc., in the pipe.

The twelve $1\frac{1}{2}$-in. sections enter the 10-in. header on 4-in. centers, making the header about 5 ft. long, so that it will fit in a 6-ft. section of closed-louver type of cooling tower.

A safety valve is placed on the 4-in. intake pipe, also a small $\frac{1}{2}$-in. drain for taking samples, etc. Thermometer wells are placed in both the 4- and 10-in. down drops.

M. C. COCKSHOTT.

Long Beach, Calif.

Locating Circuit Faults

A DETECTOR for locating grounds on a circuit without sectionalizing it, as requested by "M.D.B." in the Oct. 28 number, can be made from a radio headset. The two receivers are connected together as in the figures. The cover and diaphragm are removed from one receiver and used as the detector, while the other is held to the ear. On a normally insulated system the ungrounded side of the line is connected to ground through a resistance that will allow at least 5 amp. to flow through the ground fault, as in Fig. 1. On alternating-current circuits the resistance is connected directly to ground, as shown, but on direct-current circuits a device must be used to interrupt the current at intervals of a few seconds.

When the detector is placed near the faulty line carrying current, as at *A*, a hum will be heard in the receiver. If the detector is placed on the wire beyond the fault the hum in the receiver will be absent. Since a hum is heard at *A* and not at *B*, it is known that the fault is between those two points.

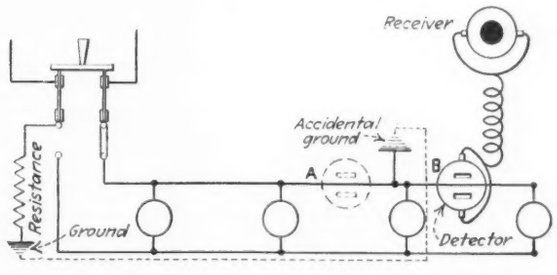


Fig. 1—Connections for locating a fault ground on a normally insulated system

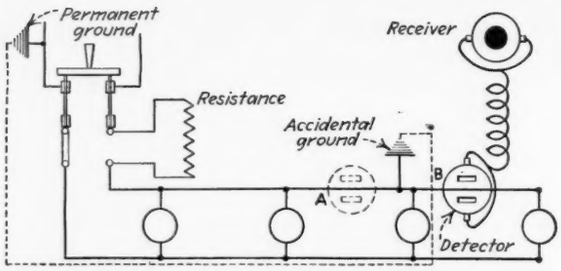


Fig. 2—Connections for locating a fault ground on a normally grounded system

On a normally grounded system the resistance is connected into the side of the line that contains the accidental ground. In this case, be sure that all devices are disconnected from the line being tested, so that the test current flows through the fault only. The test with the detector is made along the line as described for Fig. 1. The connections in Fig. 2 would also be used to locate a short circuit between two lines and the test is made as previously described. In this case, however, when the detector is placed near either conductor on the line side of the fault a hum will be heard. Absence of the hum will indicate that the fault has been passed.

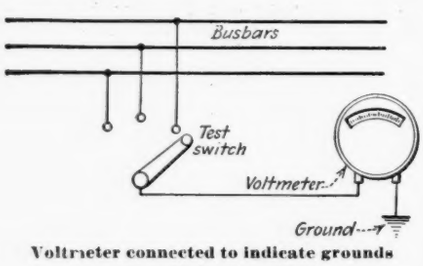
It should not be overlooked that most faults occur on the power-using devices, such as motors, heaters, lighting fixtures and in splicing boxes. It is in these places that the fault should be looked for first. On any insulated system a ground on one line should be repaired as soon as possible. If a second ground occurs on the opposite side of the line it will cause a short circuit.

Lowell, Mass. CLARENCE W. HOPE.

✦

THE STANDARDS of insulation resistance are the so-called code rules for minimum values published by the American Institute of Electrical Engineers and the National Electric Code. Some electrical engineers maintain a higher standard than given in these codes, but I have found that one megohm is a good value to use as a guide. In other words, an insulation resistance of one megohm is a fair minimum limit to allow on ordinary electrical apparatus. Those who maintain the one megohm standard find that operating results are worth far more than the effort and expense involved in making the tests.

The frequency of making tests cannot depend on any set rule, as local conditions will have to govern. A piece of apparatus in a damp or dirty location requires more attention than one in a clean and dry location. In conjunction with megohmmeter testing it is a good practice on ungrounded power systems to make a daily test for grounds in order that unexpected insulation failures may be discovered. At a plant I have in mind, where the power is 600 volts, 3 phases, the ground test is made with a simple layout, using a voltmeter, as shown by the figure. With no ground on the system the voltmeter should read practically zero. When a ground develops on one phase the meter will read about full voltage on the other two phases. The resistance of the ground will be a factor in the voltage indicated by the voltmeter, and it may read anything from zero to full line voltage, depending on the insulation resistance to ground.



Voltmeter connected to indicate grounds on a 3-phase system

Fisherville, Mass. BURTON P. ROBIE.

✦

A GOOD method of locating faults in wiring or in cables is to use the device known as a "woodpecker" to supply an intermittent current through the defective conductor and the fault. The woodpecker is an interrupter that opens and closes the circuit about 60 times per minute. A device consisting of an exploring coil and a telephone receiver is used to listen in on the cable. The buzz of the woodpecker may be heard along the cable up to the fault. When the fault is passed the sound due to the current interruptions cannot be heard. In this way the fault may be ascertained within a few feet.

Weak spots in the insulation may be found by applying an overvoltage of about double operating value plus 1,000 between each conductor and the ground and between conductors. Lamps, motors and other equipment should be disconnected from the circuits when the high-potential test is being applied. It is also advisable to connect an automatic overload circuit breaker in series with the source of high voltage so that in case of an insulation failure good wiring will not be destroyed by the arc that may develop. If the wiring's insulation fails at some weak spot when the high-voltage test is applied the exact location of the fault may be found by using the woodpecker. GORDON R. HAHN

New York City.

Making Wider Use of Split-Steel Pulleys

THERE APPEARS to be a prejudice against split-steel pulleys, and engineers in some plants will not use them. I have never heard a justifiable criticism against them and so feel that much of the prejudice is unwarranted. The split-steel pulley is safer to run at high speeds. This inherent characteristic makes it desirable on drives where speeds are likely to get out of control and exceed the safe rim limit. When this happens with a cast-iron pulley it means bursting, with possibly disastrous results to life and property. But the light weight of the rim and the strength of the split-steel pulley minimize the destructive effect.

The split-steel pulley is only about half as heavy as the cast-iron pulley, an advantage in installation. Less labor is required. The ease with which it can be handled reduces the accident hazards. It is easier on bearings, shaft hangers, ceilings and walls, and lower in cost.

Because of its light weight, a slight unbalance in the split-steel pulley is not as objectionable as in the cast-iron type. The construction of the bushings of the split-steel pulley makes it easily interchangeable between shafts of different sizes. In an emergency the split-steel pulley can sometimes be clamped tightly enough on to the shaft to carry its load without a keyway.

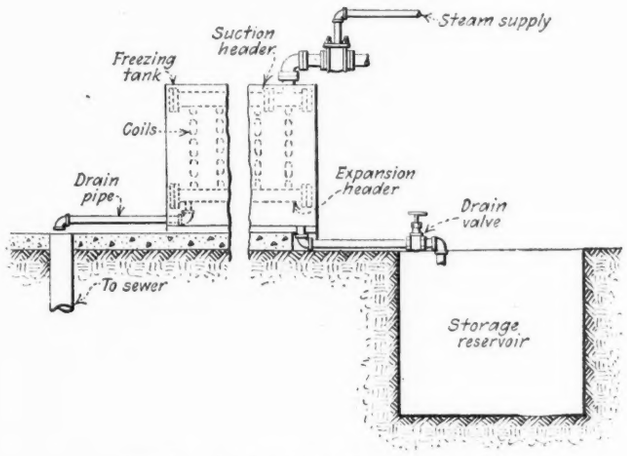
I believe, with all of these advantages, that the split-steel pulley could be more widely used than it is. I know of one instance where a 60-in. cast-iron pulley exploded, and fatally injured two workmen. This plant then changed to a split-steel pulley, which gave good service over a four-year period that I was on the job.

Niagara Falls, N. Y. MARIN PHILLIPS.

Scouring Oily Sludge From Ammonia Expansion Coils

THE OIL SEPARATOR in the discharge line from an ammonia compressor was not doing the work expected of it. About half of the lubricating oil fed to the compressor cylinders was getting into the refrigerating system. The plant had been in operation for a number of years, and the ice output had dwindled to scarcely more than half what it should be, considering the quantity of ammonia circulated. At the end of the ice season the engineer in charge decided to rid the system of the heavy deposit of oily sludge which evidently was clogging the condenser and expansion coils.

The first thing he did was to dig a hole in the ground near one corner of the rectangular freezing tank that stood a trifle lower than the other three. In this hole



Purging the freezing coils of oily sludge

he set a circular storage reservoir large enough to hold all the brine with which the system was charged. Then, by means of the gate valve and a short run of piping he drained off the brine.

The next thing was to exhaust the ammonia from the expansion coils in the freezing tank and disconnect the coils from the headers. Having done this, the engineer connected a compressed-air pipe to the upper end of one of the coils and sent a blast through under 100 lb. pressure. But only the air issued from the lower end.

Forcing a blast of steam through the coils did not appeal to the engineer, as he reasoned that some condensation might remain after the job was done. He decided to apply heat externally, hoping thus to soften the deposit so that the blast of compressed air could dislodge it. After recoupling the coils to the headers, he filled the freezing tank with water and heated it to about 150 deg. F. by piping in a number of steam jets. Then, after giving the heat plenty of time to take effect, he extended the drain piping across the open end of the brine storage tank and ran the heated water into the sewer. When he again uncoupled the coils and applied the air pressure, he got about a gallon of slime from the set of coils.

It now was plain that the only recourse remaining was to send a strong flow of steam through the coils. The engineer figured that this would be more effective if he left all the coils connected to the headers and blew them simultaneously. By running a 1-in. drain pipe from one end of the lower header, as indicated in the sketch, he provided an outlet for the sludge. After removing the bonnet from a valve in the suction connection to the upper header, he clamped a steel plate, with a 1-in. nipple screwed into it, over the opening left by the bonnet. This was the steam connection.

Having everything in readiness, the engineer turned on the steam, at about 150 lb. pressure. Some minutes passed before there was a showing at the outlet. As the steam melted the oily coating from the pipes, the force of the blast doubtless kept rolling the slime along and banking it up so that its progress toward the outlet was retarded. But suddenly a solid stream of it shot from the outlet nozzle and continued running into the sewer. In a little while the flow began to slacken; but the blast of steam was kept going until only water vapor showed at the outlet.

To get rid of the water of condensation that remained in the coils was the next problem. The engineer again disconnected the coils and blew them out, one by one, with compressed air at high pressure. After he had coupled everything up, renewing all the gaskets in the joints, he tested the tightness of the job by first pumping a vacuum in the coils and then opening the valve in the liquid line from the receiver until an ammonia pressure of about 30 lb. had been built up.

Little of the oily sludge had attached to the upper tubes of the condenser, which was of the atmospheric type. This doubtless was due to the comparatively high temperature in these tubes. The oil passed through them as a vapor, some of which condensed in the lower tubes, while most of it went on through the receiver and expansion valves into the freezing coils, where, owing to the low temperature, it formed a semi-solid mass.

St. Louis, Mo. A. J. DIXON.

Emergency Repairs to a Pump Piston Rod

UPON TAKING a position as engineer at a mine in Wyoming I was confronted with the problem of repairing the piston rod of a mine pump in which a bad groove had been cut by sharp particles of rock in the packing gland.

It was in the spring of the year, when an unusual flow of surface water was to be handled, and the condition of the rod had become so bad that it was difficult to keep the packing in the gland. To get a new rod was out of the question. It was therefore necessary to repair the rod temporarily until a new one could be obtained.

The rod was removed from the pump and a series of holes was drilled in the bottom of the groove. The entire groove and holes were filled with babbitt. When the surplus babbitt had been removed and the rod had been finished true and polished it was replaced in the pump and gave satisfactory performance.

Butte, Mont. RALPH E. MACKAY.

From Among Readers' Problems

Conducted by
L. H. MORRISON

THICKNESS OF DISHED HEAD—*Why does the Boiler Code use the formula for the thickness of dished heads as:* $t = \frac{5.5\ PL}{2\ TS} + \frac{1}{8}$, *when theoretically it should be* $t = \frac{PL}{2\ TS}$ C.V.M.

Theoretically the thickness is $t = \frac{PL}{2TS}$, but it would not be safe to use a thickness based on the ultimate strength of the metal, so a "factor" of safety is introduced. For head this is made 5.5. The constant $\frac{1}{8}$ in. added to the thickness obtained by the formula is for "good measure," to help care for unknown stresses.

COMBUSTION OF WATER—*In a recent examination one question I could not answer was, "Will water burn?" Will it?* G.S.

Water is the result of combustion, or a chemical reaction, of hydrogen and oxygen. For example, hydrogen in coal unites with the oxygen in the air, releasing 62,100 B.t.u. per pound of hydrogen, and results in the formation of 8.94 lb. of H_2O vapor, or steam. The chemical equation is

$$2H_2 + O_2 = 2H_2O.$$

The molecular weight of hydrogen is 2.016, and of oxygen 16, so using these molecular weights in the equation, $2\ (2.016) + 2 \times 16 = 36.032$.

Since the hydrogen weight is 4.032, the weight of the products per pound of hydrogen is $36.032 \div 4.032 = 8.94$, as given.

Water can be broken up into its elements, hydrogen and oxygen, but to do this heat in some form must be added, to the extent of 62,100 B.t.u. per pound of hydrogen. The temperature at which dissociation of water into hydrogen and oxygen begins varies with the pressure. At atmospheric pressure this is generally believed to start around 2,700 deg. F., in the absence of a catalyzer.

TEMPERATURE IN AMMONIA ABSORBER—*If the temperature in the evaporator of an absorption ammonia system is to be —17 deg. F. and there is no pressure drop between the evaporator and absorber, to what temperature must the absorber be kept to obtain an aqua ammonia, or strong liquor, concentration of 28 per cent?* A.B.

Water has an affinity for ammonia and will absorb large quantities of it. The amount a pound of water will take up depends both upon the pressure and temperature; or, if the solution is at a certain concentration, increasing the temperature will cause part of the ammonia to cool off, lowering the concentration.

In "Powers' Practical Refrigeration" there is a table giving the boiling temperature for various concentrations at various pressures.

As the evaporation temperature is —17 deg. F., the evaporator and absorber pressure will be the vapor pressure corresponding to this temperature, namely, 20 pounds absolute.

In the table referred to, a 28 per cent concentration at 20 lb. abs. pressure has a boiling temperature of 103.6 deg. F. The absorber then must be cooled sufficiently to hold this temperature while receiving the heat arising from the absorption of ammonia by the weak liquor coming from the generator.

STEAM TEMPERATURE IN AMMONIA GENERATORS—*What steam pressure must be maintained in the generator to boil off ammonia from the strong liquor to bring it from 38 to 28 per cent concentration, when the steam temperature is 10 deg. above the ammonia temperature and the condenser temperature is 88 deg. F.?* B.A.

If the ammonia condenser temperature is 88 deg. F., the condenser and generator ammonia pressure will be 174.8 lb. abs., this being the pressure corresponding to a boiling temperature of 174.8 lb. At 174.8 lb. pressure, a 28 per cent concentration has a boiling temperature of 236 deg. F. This is the temperature the liquor in the generator must have to boil down to a 28 per cent solution. If the steam is 10 deg. F. warmer its temperature is 246 deg. F., which corresponds to 27.8 lb. abs. or 13.1 lb. gage steam pressure.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

THE LOAD on our plant reaches a maximum of 1,875 kw. and the capacity of the generating equipment is 3,750 kva. in three 1,250-kva. 550-volt, 80 per cent power factor generators. The power factor of the load is low, around 65 per cent. Will some of POWER's *readers give me the benefit of their experience with methods of correcting power factor and the results obtained?* R.E.

IN MANY industrial plants there is a tendency to over-motor because of the fear that a fully loaded motor is more subject to breakdown than an oversize machine handling the same load. The direct result of over-motoring is a low power factor, such as experienced by "R. E." Another cause may be the use of motor of very slow speed.

Either of these conditions would be revealed by making a survey of the plant, taking wattmeter readings on all motors, and studying the possibility of applying motors of reduced size or of higher speed where possible. Sometimes it may be necessary to use oversize motors because of the starting characteristics of the driven machines; but with a careful selection of the proper type of motor that can usually be avoided. Very often a wound-rotor induction motor may be substituted for an oversize squirrel-cage motor, or a motor of the double-squirrel-cage type having a high starting torque may be used.

Seldom does a plant using only common squirrel-cage motors, properly applied, have a power factor of less than 80 per cent. I am of the opinion that in "R. E.'s" case at least a marked improvement in power factor should result from a careful weeding out of oversize and slow-speed motors. If by this means the power factor can be increased to nearly 80 per cent, there is no real need for attempting further improvement unless a material increase in power demand is anticipated. Two of the three generators will handle the maximum load of 1,875 kw. at 80 per

cent power factor with a margin of 125 kilowatts.

If, on the other hand, there is impending an increase in the demand for power, it may prove more economical to make provision for further power-factor improvement, rather than to install more generator capacity. By increasing the power factor to 90 per cent, a total margin of 375 kw. above the present load may be obtained. This would require about 610 kva. leading reactive component, based on a previous improvement to 80 per cent. Any one of the following means may be employed, the choice being governed largely by the floor space available, as well as by the cost of the equipment required:

1. Change some of the present 200-hp. induction motors for synchronous motors.
2. Install a synchronous condenser.
3. Install static condensers (capacitors).

Using method 1, two 300-hp. synchronous motors, operating at 70.7 per cent leading power factor, could replace a like number of the 200-hp. induction motors, and would handle a mechanical load of 210 hp., which would leave a margin of 10 hp. for driving the exciter required with this type of motor; and in addition furnish the necessary leading reactive component for power factor correction to permit two of the generators to supply a total load of about 2,250 kw. at 90 per cent power factor.

With method 2, the nearest commercial size of synchronous condenser would be a 750-kva. machine, for which additional floor space would be required, and might be quite expensive. Locating the unit near the load center of the motors requiring the power factor correction might become a difficult matter.

Static condensers have the advantage of being available for installation in suitable sizes at or near each individual motor, in almost any unoccupied overhead space, and they require little maintenance. They may also be arranged for switching in and out of service as required by the operation of the motors having the most detrimental effect on the power factor.

C. H. Scotness,
Chief Electrician,
Diamond Coal & Coke Co.
Diamondville, Wyo.

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OUR EXPERIENCE with a large number of power customers has shown that improved power factor can be obtained most cheaply and successfully by: (1) Rearrangement of induction motors to give nearly full load on each, or by replacement of largest units carrying constant loads by synchronous machines to operate at leading power factor; (2) installation of static condensers.

With the conditions given in the question, the load could be carried by two of the 1,250-kva. generators if the load power factor was raised to 80 per cent. To obtain this power factor, 800 leading reactive kilovolt-amperes will have to be provided with the present set-up.

Should it be possible to rearrange or replace the induction motor drives to raise the plant power factor, less than 800 leading kilovolt-amperes would be necessary to give 80 per cent. The cheapest source of a leading component would be static condensers, costing $21 to $23 per kilovolt-ampere. This method of correction is relatively inflexible, unless the condensers are split into small units distributed over the plant; but it possesses the advantage of practically no cost of operation or maintenance.

A more expensive method of correction, both in first cost and operation, will be to use a synchronous condenser. This can be obtained with automatic control to make it effective over a wide range, giving flexible operation. It would be cheaper than a spare generator unit by an amount approximately equal to the cost of the prime mover.

E. W. MacCorkle, Jr.,
Kentucky & West Virginia
Ashland, Ky. Power Co., Inc.

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I ASSUME that the capacity of the generators is limited by the steam end of the machines, therefore there would be no advantage in raising the load power factor above 80 per cent.

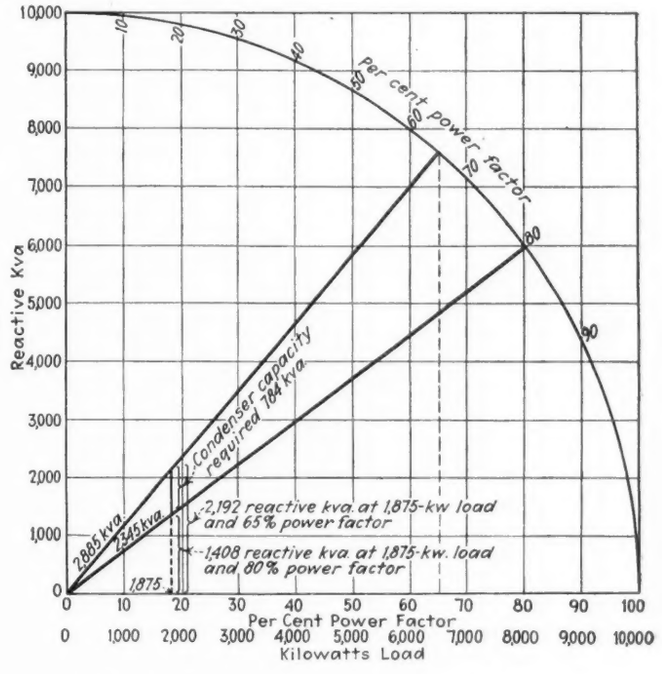

Chart for determining the capacity of power-factor correcting equipment

Meet. Assuming that the power factor is to be increased to 80 per cent, find another point on the arc, representing the 80 per cent power factor point. Connect this point by a line with the junction of the kilowatt and kilovolt-ampere lines, as in the figure. The load on the plant is 1,875 kw. From the 1,875-kw. point on the kilowatt line draw a vertical line to intersect the 65 and 80 per cent power factor lines. The vertical distance between the 65 and 80 per cent power factor lines represents to scale the required condenser capacity to correct the power factor to 80 per cent. By scaling the triangle, the size of the condenser equipment may be determined by measurement.

As a check on the scale method, and to obtain slightly more accurate results, the values may be calculated. The kilovolt-ampere load is equal to the kilowatts divided by the power factor. At 65 per cent power factor, kilovolt-amperes $= 1,875 \div 0.65 = 2,885$, and at 80 per cent power factor, kilovolt-amperes $= 1,875 \div 0.80 = 2,345$. If a table of sines and cosines is consulted, the sines of the angles corresponding to the power factors may be used to calculate the reactive-kilovolt-ampere load. When this table is not at hand, the reactive load may be obtained by taking the square root of the difference of the squares of the kilovolt-amperes and kilowatt loads. At 65 per cent power factors the reactive kilovolt-amperes $= \sqrt{2885^2 - 1,875^2} = 2,192$, and at 80 per cent power factor the reactive kilovolt-amperes $= \sqrt{2345^2 - 1,875^2} = 1,408$. The difference between the reactive kilovolt-amperes at 65 per cent power factor and at 80 per cent power factor is the capacity of the condenser that must be added to the system to correct the power factor to 80 per cent. In for which the units are designed. The diagram is designed for determining the capacity of power factor corrective equipment for any load and power factor.

To use the chart, find a point on the arc that represents the original power factor of the system. Draw a line between that point and zero where the kilowatt and kilovolt-ampere lines

this case the capacity of the condenser is 2,192 — 1,408 = 784 kilovolt-amperes.

A synchronous condenser of this size will cost approximately $7 per kilovolt-ampere, or $5,250 installed, and the operating losses would be about 40 kw. Allowing 15 per cent for interest, depreciation and maintenance, the fixed charges will be $787.50 per year, and the operating cost will be 40 kw. per hour at the cost of generating a kilowatt-hour in the plant.

If it is expected that the load will increase at the 65 per cent power factor, it might be desirable to install a 1,000-kva. condenser instead of the 750. The 1,000-kva. condenser would allow loading the two generators to their maximum capacity at 80 per cent power factor with a load power factor of 65 per cent, or even somewhat less.

Wyomissing, Pa. C. R. KEMP.

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IN THE case under discussion there are three 1,250-kva. 80 per cent power factor generators, and a maximum peak of 1,875 kw. Since each generator has a capacity of 1,250 × 0.80 = 1,000 kw., two of them would easily carry the peak load if it were not for the low power factor. Since the power factor is 65 per cent, the peak kilovolt-ampere is about 1,875 ÷ 0.65, = 2,884. As the generators are rated at 1,250 kva. each two of them will not carry the peak if it is of long duration or occurs too frequently.

No doubt this condition necessitates operating the third unit for at least a portion of the time. This will likely lower the station efficiency, for the following reasons:

1. The units operating at reduced load will require more steam per kilowatt-hour than two machines fully loaded.

2. The steam or electrical energy consumed by the auxiliaries of the third unit will represent a net loss.

3. Boiler efficiency may be adversely affected, due to banking an extra boiler for use when the third generator is operating.

4. Operation of the system will be jeopardized to a certain extent, because there is not a spare generator. If only two machines were required to carry the load, one could be kept as a spare at all times and a regular schedule of inspection and maintenance carried out conveniently.

Judging from the low power factor, at least some of the induction motors on the system are operating underloaded. It may be possible to interchange several of them, putting each motor on a load comparable with its rating. If the motors can be fairly well loaded the power factor will be improved, but the plan would likely require purchasing a few new motors. This plan might be successful, since it is only necessary to raise the power factor to 1,875 ÷ 2,500, or 75 per cent for two generators to supply the load.

It would likely be possible to substitute synchronous motors for some of the larger induction motors. The synchronous motors should be designed to operate at 80 per cent leading power factor at full load. The only objection to this plan is the cost of making the change.

It might prove economical to shut down some of the motors for the duration of the peak. Some of the machines might be dispensed with for a short time at no loss in production. Since a reduction of only a few hundred kilovolt-amperes would enable two machines to supply the peak, this plan would at least bear investigation.

Beaumont, Texas. M. F. KNOY.

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A Question For Our Readers

IN OUR 300-bed hospital the water from the city mains is reduced to zero hardness for all parts of the institution.

Upon opening the hot water heaters after 15 months' use we found the shell badly pitted, which will mean new heaters at the end of three years. How can this be overcome?

E.L.E.

Suitable answers from readers will be paid for[1] and published in the March 3 number

▼

THE PLANT with which I am connected has a maximum load of about 1,800 kw. There are a few large motors of ratings up to 150 hp., and about 700 motors ranging from ½ to 3 hp. Altogether, there are 750 hp. of synchronous motors, designed for 75 per cent leading power factor. There are also five Fynn Weichsell motors operating at unity power factor. We maintain the power plant factor around 90 per cent at all times. All our power is purchased, and we have to maintain the power factor above 85 per cent.

In the plant mentioned in the question it might be possible to improve the power factor somewhat by changing motors that are considerably underloaded, so as to have them operating at as near full load as possible. If the plant has a large number of small motors, it will not be possible to get a power factor much above 75 per cent by this means.

If the power factor can be increased to 85 per cent with the existing load, 2,200 kva. generator capacity will be required. This is within the rating of two generators. The power factor could be corrected to between 85 and 90 per cent by installing a 1,200-kva. synchronous condenser, leaving the rest of the plant as it is. The condenser would cost considerably less than another steam turbine-driven generating unit.

A better way of correcting the power factor would be to install synchronous motors in place of induction motors on some of the large units. Motors that operate continuously, and at fairly steady load, are the best ones to exchange. If 600 kva. capacity of 75 per cent power factor synchronous motors is installed in place of the three 200-hp. induction motors, the plant power factor will be raised to about 80 per cent, assuming that the remainder of the load operates at 65 per cent power factor.

The exact capacity of the synchronous machines can be determined only after an analysis of the power factor of the plant with and without the machines it is proposed to change. Replacing the induction motors with synchronous machines involves no additional floor space, as would be required by the synchronous condenser, and although the three 200-hp. motors when installed will not cost very much less than the single synchronous condenser, there will probably be a fair resale value for the induction motors.

C. E. OLIVE, *Chief Engineer,*
Canadian Celanese, Ltd.
Drummondville, Que.

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THERE ARE three ways of correcting the power factor: By reducing the size of the motors, installing capacitors, and replacing induction motors with synchronous motors. The cost of making changes is perhaps the most important item to be considered. From the description given it is evident that the induction motors are between only 50 and 75 per cent loaded.

In an industrial plant there are usually enough applications so that 100-hp. motors may be replaced by 75-hp. units, 50-hp. by 40-hp., etc.

By interchanging the motors to obtain better loading, the power factor could probably be raised to 80 per cent. In our own plant we improved the power factor from 65 to 75 per cent in that way.

If the power factor has been improved as much as possible by interchanging motors, and it is not as high as desired, recourse must be had to replacing induction motors with the synchronous type, or to installing capacitors.

Lowell, Mass. CLARENCE W. HOPE.

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[1]Instead of cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired.)

Morrison's *American Diesel Engines;* Walker and Crocker's *Piping Handbook;* Norris and Therkeisen's *Heat Power;* Emswiler's *Thermodynamics;* Church's *Steam Turbines;* Uehling's *Heat Loss Analysis;* Croft's *Steam Power Plant Auxiliaries and Accessories;* Powell's *Boiler Feed Water Purification;* Osborne's *Power Plant Lubrication;* Moyer and Fittz' *Refrigeration;* Rietschel-Brabbee's *Heating and Ventilation;* Annett's *Electric Elevators.*

Permissible Acidity of Oil For Turbine Circulating Systems

By CHARLES A. R. de CARVAJAL*

ALTHOUGH other considerations besides excessive acidity in steam turbine oils may decide its lubricating value, lubricating engineers in general are agreed on a maximum of 0.3 per cent total acidity, in terms of the amount of hydrogen-ion available, as the time when steps should be taken to purify the oil.

Acidity of a sample of oil, taken by itself, should not be considered as an index of its condition. Some of the acids produced in the ageing of turbine oils are not only very weak, being but slightly ionized because of their extremely low solubility in water, and also little corrosive, but they do not polymerize to form sludge deposits. Their presence will give a higher acid index, but will not indicate an increased tendency of the oil to sludge.

Composition of Oil

Turbine lubricating oil, consisting mostly of a complex mixture of aliphatic hydrocarbons of the paraffine series (C_nH_{2n+2}), composed of members of this series distilling at temperatures of 300 deg. F. and over, such as heptadecane ($C_{17}H_{36}$) and other members of higher molecular weight, contains also an amount of unsaturated hydrocarbons of the olefin (C_nH_{2n}) and acetylene (C_nH_{2n-2}) series, as well as cyclic hydrocarbons, which either were originally present in the crude oil, or later polymerized from the aliphatic compounds. These cyclic hydrocarbons are the ones which oxidize, turning into organic acids and sulphonate in contact with sulphuric acid, only to set it free again when the oil deteriorates.

Turbine oil should be a pure petroleum product carefully refined, of flash point in the open cup tester not below 315 to 335 deg. F., and viscosity at 100 deg. F. from 150 to 310 sec., Saybolt viscosimeter, depending on the grade of oil.

Deterioration of the oil, giving rise to the formation of organic acids, is due to oxidation and hydrolysis of the unsaturated compounds containing sulphur, nitrogen and oxygen. This process is accelerated by heat, contact with air, and the presence of water and impurities, acting as catalytic or carrier agents, accumulated during circulation in the lubricating system.

The objection to excessive acidity is that, in combination with water present in the oil, it usually forms sludges, metallic soaps which accelerate sludging, and emulsions. These are deposited along the lubricating system, over the oil cooler pipes, where they prevent the proper heat transfer and generally impair the lubricating value of the oil. Metallic soaps are formed by the action of the organic acid content in the total acidity, which dissolves zinc or alloys of that metal, upon bearings and articulations of the governor mechanism.

Two types of deposits, or sludges, due to polymerization of the organic acids subjected to the action of heat and pressure are found during the course of deterioration of the oil, the oil-soluble and the oil-insoluble. The oil-soluble dissolves itself in the oil at average operating temperature. It is objectionable in that oil containing it, in passing over the oil cooler tubes, deposits the sludge on them because of the lower temperature, thereby preventing proper heat transfer. It also accumulates deposits in other parts of the system where the oil is relatively quiet and the temperature drops sufficiently to cause it to solidify. Insoluble sludges are carried with the oil in circulation, forming deposits in the oil pipes and passages.

Sludge is the generic name given to all deposits found in lubricating systems. It may consist of a slimy mass composed of an emulsion of water, oxidized hydrocarbons, other impurities and a large proportion of otherwise good oil, of a somewhat dry deposit of oxidized hydrocarbons.

Acids found in lubricating oils are classified as mineral and organic. A knowledge of the procedure in determining them is valuable to the power plant engineer whenever the services of a chemist are not immediately available, and should be encouraged, along with other oil tests, as being quite within the scope of his activities. A brief description might not be out of place here for the benefit of those who are not familiar with its details.

Mineral acids, usually in the form of sulphuric acid, are present because of the formation and incomplete subsequent removal of sulphonic acids formed in treating the oil with sulphuric acid during its refining. In contact with water these sulphonic acids react with it and break down, one of the resulting products being sulphuric acid.

Test Procedure

The test procedure is as follows: Weigh 25 to 50 grams of oil into a 500-ml. (milliliter) separatory funnel; add 300 ml. of hot distilled water, recently boiled, and shake thoroughly. Titrate the water while still hot with 0.1 normal solution of NaOH (sodium hydroxide, caustic soda), using phenolphthalein as indicator. Run a blank on the same amount of water and subtract the blank titration from the previous. This second titration is made in order to account for the acidity in the water itself, if any. Calculate the difference to H_2SO_4 (sulphuric acid), one ml. of 0.1 normal NaOH being equal to 0.0049 gram of H_2SO_4.

The amount of mineral acid allowable in terms of free H_2SO_4 is 0.03 per cent for turbine oils.

For a total acidity test weigh 10 grams of the oil into a flask and add 50 ml. of a mixture of equal volumes of water and 95 per cent C_2H_5OH (ethyl alcohol) which has been neutralized with very dilute NaOH solution. Heat to boiling, agitate the flask thoroughly and titrate while hot with 0.1 normal solution NaOH free from carbonates. Phenolphthalein, alkali blue 6B or turmeric may be used as the indicator.

For organic acids calculate the number of milliliters of 0.1 normal solution of NaOH required for one gram of the sample in the total acidity determination and also in the mineral acid determination. Subtract the latter from the former and calculate the difference to oleic acid. That is, $(CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$, or $C_{17}H_{33} \cdot OH)$. One ml. of 0.1 normal NaOH = 0.0282 gram $C_{17}H_{33} \cdot OH$.

Chemists consider oil free from acids when the total acidity is below 0.03 per cent. Good turbine oil contains less than 0.008 per cent acid when new.

Watch the Oil

The most common way of watching the condition of lubricating oil is the visual method, by which samples of definite size to be kept in glass bottles are taken at regular intervals, dated and allowed to stand undisturbed. The sample of oil should preferably be taken from a point where the oil leaves the turbine bearings, to be representative of the oil actually in circulation. In this way comparison of the amount of insoluble material settling may be made, the trend noted, and any unusual rate of deposit easily detected. Other tests of the oil should be made and the cause for this unusual deposit ascertained. But the full usefulness of the visual method is not available unless the data on the condition of one sample taken as a reference, and the physical and chemical indices corresponding to a unit of increment in deposits, are known.

Of course the best indicator of the condition of the oil, from day to day, is the temperature record of oil and water in and out of the oil cooler, with constant volumes of oil and water passing through the coils. A marked decrease in heat exchange indicates an accumulation of deposits.

A 2,000-kw. turbine should be provided with an efficient continuous bypass oil purification system, preferably of the processing tank and centrifugal separator combination type, which is the most efficient method and the one most generally employed for this size and upward. Turbine oils purified by this method often do not indicate more than a maximum of 0.25 per cent acid content after two years of use, show slight difference in other respects compared to new oil and otherwise are as fit for use.

*Written as an answer to the question discussed by *Power* readers in the Jan. 13 number.

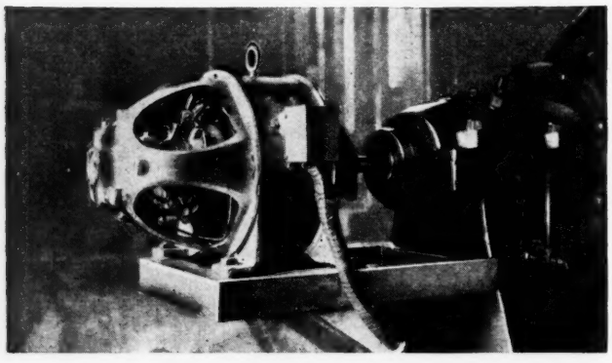
WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Power-Factor-Control Unit for Synchronous Motor-Generators

TO provide a practical means of maintaining an even and uniform power factor on any synchronous motor-generator set, the advantages of which are well known, the Melton Control Company, Punxsutawney, Pa., has introduced a control system, the operating unit being shown in the accompanying illustration.

The system comprises, essentially, an exciter directly connected to the main generator shaft, with the fields so connected that any change of the main generator load automatically increases or decreases the excitation of the synchronous motor. The armature of the exciter is permanently connected through the rheostat to the fields of the synchronous motor. The shunt fields are connected through a rheostat to the direct-current busbar, and the series fields, which are connected compound, receive their energy from a special shunt in the main negative lead of the generator.



Operating unit of the Melton power-factor control is directly connected to the main generator shaft

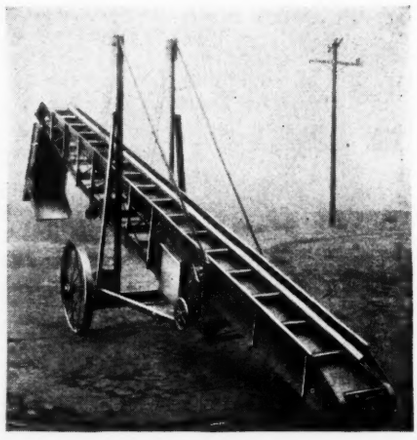
With this system the excitation of the synchronous motor is varied from approximately 50 to 150 per cent of the rated field current, the exciting current being automatically reduced below normal at low loads and raised about normal during momentary or sustained overloads. This variable excitation limits the amount of wattless component furnished by the synchronous motor, which, in turn, permits the desired constant power factor.

It is pointed out by the manufacturer that the operation of the control is simplified by the fact that it operates without relays, solenoids or series torque motor with resistance.

New Flight Conveyor

A NEW standard flight conveyor (Model 65) with sectional truss boom, swiveling wheels and finger-tip-control power boom hoist is announced by the Barber-Greene Company, Aurora, Ill. This new machine is designed for handling all sizes of coal and coke, and has a capacity of a ton of coal a minute. It is available in three boom lengths, 20, 25 and 30 ft., and is built in sections so that a 20-ft. boom machine may be converted into a 25- or 30-ft. machine, or vice versa. It is powered with a 5-hp. ball-bearing motor.

An important feature of the machine is the power mechanism for raising and lowering the boom. The power hoist is engaged when a lever is thrown. When the lever is released from the hand, it automatically snaps back into place, disengaging the power hoist and fixing the boom angle. The lowering of the boom is accomplished by means of a hand-operated band brake. For greater storage capacity from a single loading point, the wheels may be swiveled and the conveyor moved in a semicircle without changing the feeding end.



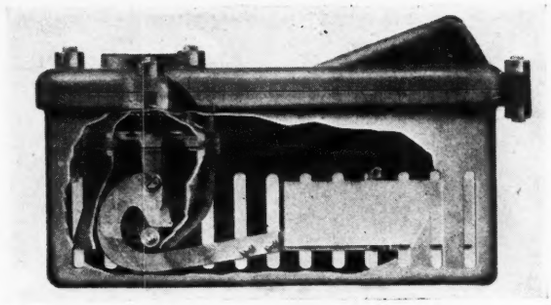
Flight conveyor of one ton capacity

The trough of the boom is made wide and deep, and the flights are of special pressed steel, reinforced and fastened to the flight chain with swivel attachment links which prevent strain or breaking should the flights get out of alignment. The snub drive is equipped with self-adjusting spring-type take-ups.

Automatic Suction Valve for Sump Service Pump

TO MAKE POSSIBLE the use of a single pump to empty a number of sumps that are located reasonably close together, although at different levels, in place of a separate pump in each sump, the automatic suction valve shown has been developed by the La Bour Company, Inc., Elkhart, Ind.

As will be apparent from the illustration, the valve is float-controlled, but not float-operated. It is closed, and locked in that position by the



With this automatic suction valve sumps at various levels can be handled by one pump

weight of the float acting through an arm against a roller attached to the valve stem. As soon as sufficient water flows into the sump the float is lifted and the cam rotates out of the way of the roller. The suction of the pump then opens the valve and draws the water out of the sump.

This operation continues until the water drops low enough to permit air to enter at the bottom of the valve skirt and pass through the valve opening, allowing the valve to drop momentarily when the impact of water ceases. This permits the float to drop and lock the valve in the closed position.

Opening and closing of the valve is thus accomplished by snap action. When the pump is not in operation the weight of the water in the suction line closes the valve and prevents return flow regardless of the position of the float.

The valve is compact and can be installed in almost any location. The exterior casing of a 2-in. valve is only 8½ in. high and 10x15 in. in area.

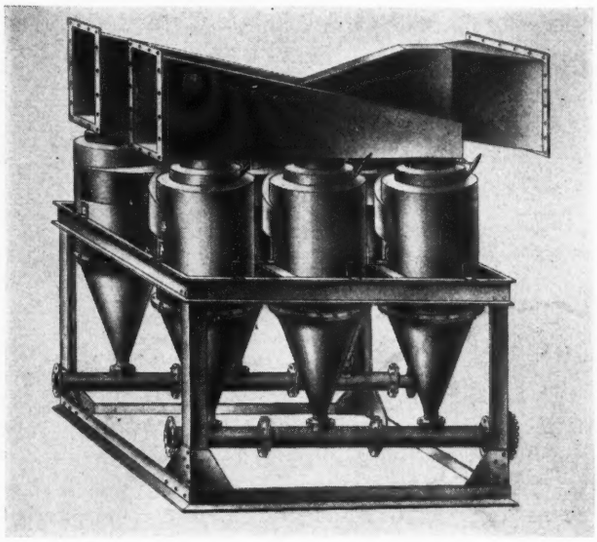
Where corrosive water is to be encountered all parts of the valve, including the casing, may be made of special materials to resist the corrosive action.

Thermostatically Controlled Radiator Valve

FOR CONTROLLING automatically the steam supply to each radiator on two-pipe steam, vapor or vacuum systems the American Radiator Company, 40 West 40th St., New York City, has introduced the thermostatically controlled radiator valve illustrated.

Designated "Arco Radiatherm," the valve is made in three types, No. 230, shown, adapted to cast-iron radiation either with or without inclosures and where there is a constant supply of steam at the valve; Nos. 225 and 226, remote control units, are for all types of radiation, either with or without inclosures and with either a constant or intermittent steam supply. No. 230 is connected horizontally, as shown, while the remote-controlled units are connected with the body in a vertical position and with the bulb attached to the inclosure or wall. Temperature adjustments are provided on all types.

Operation of the valve is comparatively simple. A compression spring holds the valve open or partly open. When the temperature rises above that for which the valve is adjusted the liquid in the thermostatic bulb expands and a small portion is forced through a capillary tube into a hot chamber. Here the liquid is quickly evaporated and generates sufficient pressure to overcome the effects of the spring, and the valve closes. When the room temperature drops below the desired point the liquid in the thermostatic bulb contracts and draws the gas out of



Thermix type 5 multi-cyclone dust collector has a variable number of small-diameter cyclones arranged in a compact right- and left-hand unit

Multi-Cyclone Dust Collector

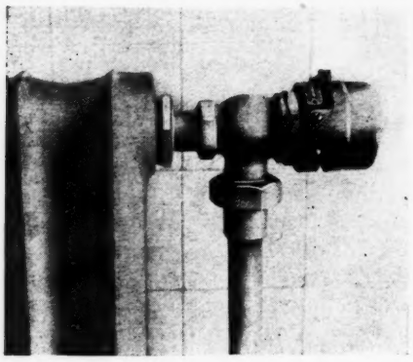
AS A SUPPLEMENT to its Thermix type No. 4 dust collector which utilizes the centrifugal force set up in a fan scroll in conjunction with one or more cyclones in parallel, the Prat-Daniel Corporation, 183 Madison Ave., New York City, has brought out the No. 5 multi-cyclone dust collector, illustrated, without a combined fan.

The new unit is especially applicable for installation where sufficient draft exists to permit the introduction of its resistance to the gas flow or where an induced-draft fan of sufficient capacity to take care of the added resistance of a dust collector is already installed.

In this collector a variable number of small diameter cyclones are arranged in a compact right- and left-hand unit, all of the cyclones being standard in size and dimensions. As will be apparent from the illustration, the gas enters through a single central duct, distributes to the various cyclones, as controlled by dampers on the inlet to each cyclone, and leaves the unit through a dual discharge.

An important feature of this design is the ability to change automatically, with varying requirements, the number of cyclones in operation. It also permits the use of small-diameter cyclones. This is said to be of particular advantage because of the interrelationship between the specific gravity of the particle to be collected, the thickness of the layer of gas through which the particle must travel to reach the wall of the cyclone, the radius of the cyclone and the velocity and viscosity of the gas.

The cyclones are lined with steel or cast-iron wearing plates that are readily interchangeable in any unit. The wearing parts in the duct work are similarly protected. Removal of the dust from the bottom of the cyclones is accomplished by means of small-diameter screw conveyors.



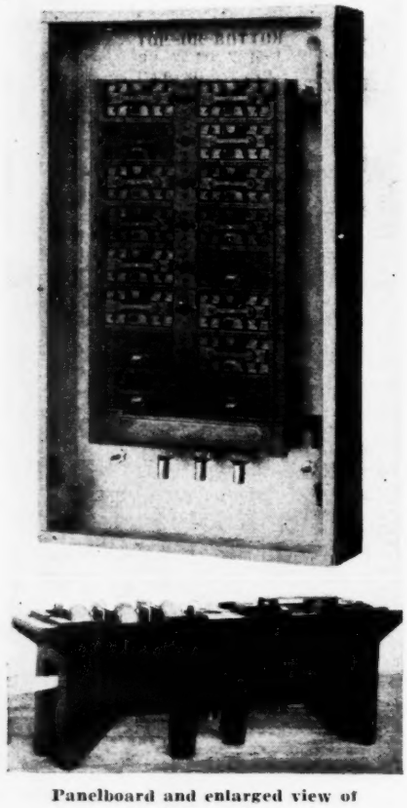
Standard type No. 230 installed on radiator

the hot chamber. The gas is condensed while passing through the tube, hence the pressure is released and the spring opens the valve. Actually, the valve takes a balanced position, open only enough to supply the necessary steam to maintain the desired room temperature.

The adjustable range of the valve is from 35 to 80 deg. It is made in three sizes, $\frac{1}{2}$-, $\frac{3}{4}$- and 1-in. diameter pipe.

Improved Sixteen-Circuit Panelboard

A RECENT ADDITION to the line of panelboards put out by Bull Dog Electric Products Company, 7610 Jos. Campau Ave., Detroit, Mich., is the sixteen-circuit three-wire panel shown in the upper view of the illustration. This panel is an assembly of double-branch, three-pole, 30-amp. bakelite units shown in the lower view. The illustration gives a front view of a unit with the fusible switch heads removed. The cabinet is only 32 in. high, 19 in. wide and $5\frac{1}{2}$ in. deep.

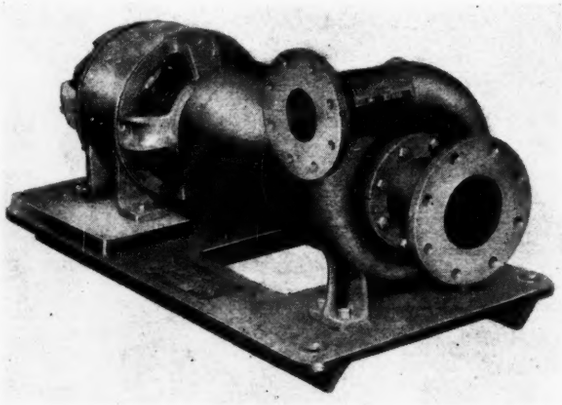


Panelboard and enlarged view of single unit

Small Hydro-Electric Plant for Emergency Lighting

TO PROVIDE a small generating unit for emergency lighting in industrial plants, public buildings, etc., the Fitz Water Wheel Company, Hanover, Pa., has brought out a completely self-contained direct-connected unit that is operated from the plant or city water pressure. The unit is built in the following sizes of inlet, $2\frac{1}{2}$-, $3\frac{1}{2}$-, 5-, 8- and 12-in., and the head range is from 10 to 100 ft., with special runners for higher heads.

A positive-type governor is incorporated in the unit and is totally inclosed. In all sizes, the shaft is of stainless steel. Direct- or alternating-current generators are supplied regularly, at voltages of 125 or 250 volts in capacities up to 20 kilowatts.

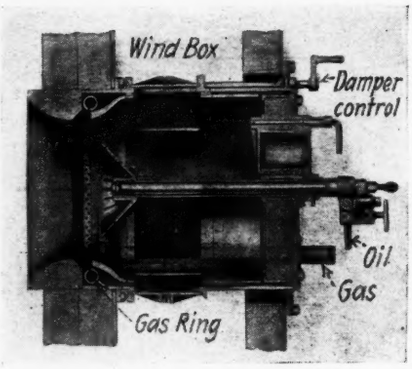


Fitz hydro-generator unit made in sizes up to 20 kilowatts

New Register for Gas, Oil and Pulverized Coal

THE LATEST register brought out by the Coen Company, Inc., Story Bldg., Los Angeles, Calif., is known as Type C and has a square frontal design. It has been built to meet conditions requiring a forced draft with preheated air running up to 1,000 deg. F. It is also suitable for either natural or induced draft.

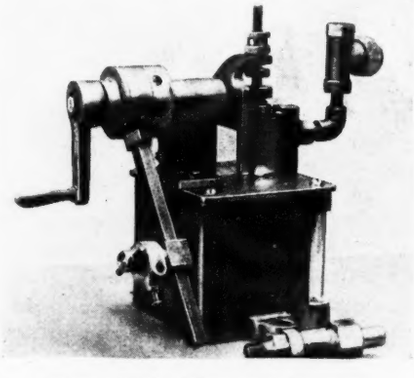
The usual vane wheel has been eliminated, air being taken through four large tangent ports, giving the same effect as a vane wheel but materially reducing air friction. All parts of the register are constructed of heat-resisting metal and are easily accessible. It may be used separately for either oil, gas or pulverized fuels or in combination.



Section of Type C register

New Driving Mechanism for Oil Lubricators

THE K-K (Kam-Klutch) drive, or the ratchet type of driving mechanism, is now obtainable on lubricators built by Hills-McCanna Company, 2349 Nelson St., Chicago, Ill. The K-K mechanism comprises a right-hand part which attaches to the standard and holds the crankshaft



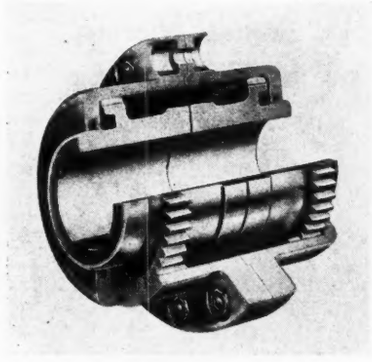
Kam clutch drive on lubricator

when on the back stroke, and a left-hand part which attaches to the driving rod operating the crankshaft on the forward stroke. The principle of the Kam-Klutch is spring-held rollers embodied in a housing that work with and against the crankshaft when operating. The drive permits attachment to high-speed driving arms in any position within the arc of a complete circle, and likewise gives the lubricator greater speed in oil delivery. This drive is interchangeable with the present ratchet drives.

Another feature is the new-style charging arm, or crankshaft, for flushing cylinders when starting up.

Medium-Duty Coupling

A COUPLING designed especially for light- and medium-duty drives, such as small pumps, fans, blowers, conveyors, etc., supplements



Coupling for light- and medium-duty service

the regular line of couplings put out by Poole Engineering & Machine Company, Baltimore, Md.

Design follows closely the heavy-duty geared-type coupling put out by the same manufacturer. Both sleeves and hubs are machined from solid bars of high-carbon steel. Sleeve members and end plates are integral. Three sizes of the coupling are available, 1-, 1½- and 2-in. bore diameters, with capacities ranging from 3 to 20 hp. per 100 r.p.m. Overall lengths range from 4 to 7 inches.

Tractor-Mounted Swing Crane With Air Compressor

IN THE Nov. 19, 1929, issue of *Power* the "Loadmaster" tractor-mounted swing crane, put out by Frederick H. Poor, Inc., 342 Madison Ave., New York City, was illustrated and described. In the latest design of this unit the tractor frame has

Loadmaster swing crane compressor unit

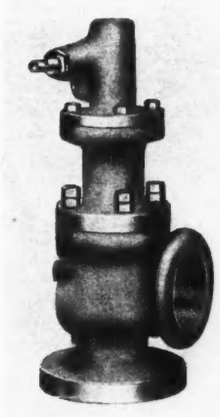
been extended to carry a 160-cu.ft. two-cylinder air compressor arranged to be driven from the tractor motor. A receiver is carried on the side, as shown in the illustration.

The complete unit is mounted on a McCormick-Deering 16-20 industrial tractor and is fitted with a 10-, 12- or 14-ft. boom, as required. The crane is rated at 3,500 lb. capacity.

Among the many uses to which this tractor can be put around power and industrial plants are setting of poles in transmission lines, handling piles, unloading cars, and similar work within the capacity of the unit, as well as supplying compressed air for various services.

Relief Valve With Pressure-Tight Lifting Lever

TO OBVIATE the usual leakage encountered on relief valves fitted with lifting levers and to provide a safe valve for use where back pressure may be encountered, the Crosby



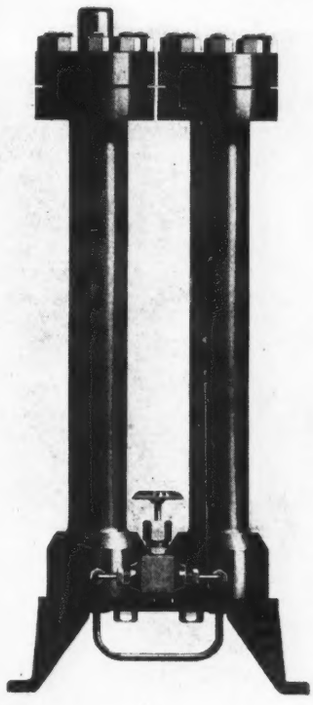
Safety relief valve with closed top and packed lifting gear

Steam Gage & Valve Company, 10 Roland St., Boston, Mass., has introduced the relief valve with a pressure-tight lifting lever as illustrated.

With this arrangement the valve relieves automatically, as in the case of any safety relief valve, but the disk can be lifted from its seat by means of the packed lifting gear without escape of liquid or vapor on the discharge side. On installations where back pressure may be encountered, the packed design prevents release of this pressure to the atmosphere. The valve is available in a number of sizes.

Flow Meter Bodies for High Pressures

TWO METER BODIES, model H-1500, for pressures up to 1,500 lb., and model H-5000, for working pressures up to 5,000 lb., are now



Model H-5000 flow-meter body

being put out by the Republic Flow Meters Company, 2240 Diversey Parkway, Chicago, Ill. Model H-1500 is furnished to measure the flow of steam, water, gas or air, on a maximum differential pressure ranging from 72 to 287 in. of water, and any pressure up to 1,500 pounds.

The pressure chambers are made of heavy seamless open-hearth tubing with flanges and top caps made from solid blocks of steel. The bottom flanges are screwed to the pressure chambers against a gasket and are back-welded.

Both meter bodies are adaptable to practically any type of valve or fitting. The model H-5000 body is illustrated.

NEWS of the FIELD

Announce Details of 20,000-Kw. Mercury-Vapor Unit for New G. E. Plant at Schenectady

New station will be an outdoor steam plant and will supply industrial and utility demands

A 20,000-KW. MERCURY-VAPOR TURBINE-GENERATOR is to be installed at Schenectady, N. Y., in a new power plant that will be outstanding in several respects, it has been announced by Burton L. Delack, manager of the Schenectady Works of the General Electric Company. It will be one of the first outdoor steam plants and will have co-ordinated industrial requirements and utility sources of power. The mercury-vapor turbine will be twice as large as the Schenectady-built unit in service at the South Meadow station of the Hartford Electric Light Company and, because of increased pressure and temperature of operation, it will be even more efficient than the Hartford installation.

The new $4,000,000 generating station, which will be leased and operated by the New York Power & Light Corporation, will supply electricity for the power company's transmission system and steam for use in the G.E. factory. It will be located on land recently made available for development when a city road was moved from within the General Electric property to the Mohawk River bank.

One of the present steam generating plants of the company, near the front end of the plant, will no longer be used and its twenty old boilers will be dismantled. Steam for the operation of the non-condensing steam turbine in the building will be supplied from the new power station, being conveyed there by pipes in a reinforced concrete tunnel more than three-fifths of a mile long. The other generating station within the General Electric works, which will be connected with the new station by a tunnel a few hundred feet long, will be retained for some years to come.

In addition to the 20,000-kw. mercury boiler and turbine, the new outdoor station will include a steam boiler to supply 300,000 lb. of steam per hour, in addition to the byproduct output of 330,000 lb. per hour from the mercury condenser, for process, heating and testing steam in the G.E. works. Adjacent to the power station site is the substation, through which the electric energy from the mercury turbine will be supplied to the 110,000-volt transmission system of the power company.

The design and erection of the new plant are being handled by the construction engineering department of the General Electric Company, of which A. R. Smith is in charge, with engineers of Stone & Webster and of the New York Power & Light Corporation in advisory capacity.

For the Schenectady installation the mercury boiler drums will be longer than those of the 10,000-kw. equipment at Hartford, but the furnace width will be no greater. The design of the unit was based on generating 20,000 kw. from the mercury turbine and 240 lb. of steam per hour made by condensing mercury (the additional 90,000 lb. of the 330,000 already referred to is obtained from the water walls). The doubling of the Hartford capacity will be obtained by increasing the mercury pressure to 125 lb. gage and by installing mercury heating surface on the upper portion of the furnace walls.

BY THUS protecting the furnace walls, the heat liberated in the furnace can be greatly increased over that at Hartford, where the furnace walls are air-cooled. Moreover, the combustion air can be preheated to a higher temperature than was considered desirable with the Hartford furnace. Therefore, a low flue-gas temperature to the stack can be obtained without the use of a water economizer. This will permit a greater application of regenerative feed heating with the steam cycle in case condensing steam turbines are used for the generation of power.

When pulverized fuel is burned, the lower portion of the furnace walls should for the present be protected by water heating surface. The fuel economy will be somewhat impaired with this arrangement of furnace as additional fuel is needed to generate steam directly in the furnace walls. Further experience is needed before the entire furnace walls can be protected with mercury heating surface.

With a load of 20,000 kw. on the mercury turbine and with the power developed from the 240,000 lb. of steam generated at 400 lb. pressure and 350 deg. F. by condensing the mercury vapor, the expected fuel rate will be 8,800 B.t.u. per net kilowatt-hour. With water cooling in the lower part of the furnace, the fuel rate will be from 9,100 to 9,500 B.t.u. per new kilowatt-hour, depending on the amount of steam generated directly in the water-cooled furnace walls.

Engineering Council Holds Annual Meeting

TWENTY-FIVE national, state and local engineering societies having a constituent membership of 59,000 professional engineers sent representatives to the annual meeting of the American Engineering Council, held in Washington, D. C., Jan. 15 to 17, at the Mayflower Hotel. The annual dinner was held on Friday evening, Jan. 16, at which the principal speakers were General Lytle Brown, chief of engineers, U.S.A., who spoke on the subject of "Engineers, Builders and Executives," and Dr. George Otis Smith, chairman of the newly created Federal Power Commission, who spoke on the subject "Words, Facts and the Truth."

Purdue Establishes Research Foundation

RAPID DEVELOPMENT of research work at Purdue University, Indianapolis, Ind., is seen in the recent filing of articles of incorporation of the Purdue Research Foundation, a non-profit organization whose prime purpose is to assist in the financing of the research projects and handling of matters pertaining to inventions and patents for the benefit of the state at large, the university and industrial organizations directly concerned.

Calls upon the university by industries of Indiana especially during the last few years, for assistance in solving scientific problems vital to their growth, have increased with the growing economic importance of the state in national affairs, according to an announcement of the university. Recognizing the need for more constructive co-operation, the board of trustees of the university in 1927 authorized organization of a special

department to handle research relations with industry. G. Stanley Meikle, a well known consulting engineer, was chosen director of the newly created department. As a result of his work, direct co-operation between industry and the university has grown rapidly. This has led to the organization of the foundation to assume the legal and financial responsibilities of the rapidly expanding research program.

Construction of Herndon Steam Plant Authorized

AUTHORIZATION has been granted by the California Railroad Commission to the San Joaquin Light & Power Corporation to construct a 50,000-kw. steam plant at Herndon, on the San Joaquin River, about ten miles north of Fresno, Calif. In addition to the power plant, the construction authorized includes 50 miles of 12-in. gas transmission line from Kettleman to Herndon; 65 miles of 12-in and 8-in. gas transmission line from Fresno to Merced, a new electric substation and a 100-mile, 220-kv. transmission line, which will tie in with the P.G.&E. system through a switching station at Bellota. The new steam plant is designed for operation at 1,450 lb. pressure and is planned as an outdoor station.

It is estimated that the new facilities will provide an additional outlet for Kettleman natural gas of some twelve to fifteen million cubic feet per day. At the present time there is being produced from eight wells in Kettleman Hills field an average of 550,000,000 cu.ft. of natural gas per day, of which 200,000,000 cu.ft. are being utilized and 350,000,000 cu.ft. blown to the air.

London Smoke-Abatement Law Modified As Result of Industrialists' Protests

BECAUSE of certain protests made by British industrialists, the London County Council has agreed to modify considerably the proposed smoke abatement by-law. Applying to every class of industry, the by-law, as originally drafted, would have entailed heavy expense, and in some cases a complete redesigning of industrial power plants in the area covered by the council. Under the National Smoke Abatement Act certain industries using special processes were given exemption, but under the terms of the new council by-law such nationally exempted industries would have been subject to it, virtually putting them out of operation in the county.

As a result of these protests the final amended draft of the by-law, which has been approved by the public control committee of the council and circulated to its constituent authorities for approval, allows exemption for all processes exempt in other areas. Furthermore, the period before the regulation covering the two-minute emission of smoke becomes operative is five years, which means that, taking into consideration the time before the by-law would go into effect, almost a six-year period of grace is given firms in which to introduce modifications in fuel consumption control so as to conform with the requirements of the by-law.

In view of this modification, it is interesting to note that the Health Ministry, realizing the need of a clearer definition of what constitutes a smoke nuisance, has invited the Department of Scientific and Industrial Research to supply reliable information concerning the use of optical methods for estimating the solid content of emissions from industrial chimneys. The lack of simple optical methods of this kind has rendered ineffective Section 2a of the Smoke Abatement Act, 1926, which empowers local authorities to frame by-laws prescribing the color, density or content of industrial smoke, thereby establishing the presumption that smoke in given cases may have been a nuisance. A few attempts made by local authorities to frame by-laws under this section have been unsuccessful, because, in the absence of scientific data, the by-laws could not contain a specific definition.

The Department of Scientific and Industrial Research, after consulting its atmospheric pollution research committee, has responded to the ministry's request by a decision to carry on experimental work at the Fuel Research Station at Greenwich. So far, experiments at the station on one type of boiler show a close relation between the opacity and density of smoke. These tests will now be extended to other types of boilers to see whether, with a greater range of variables, the same empirical relation still holds.

Other investigations by the department have resulted in the invention of an apparatus of simple design for testing the amount of sulphur pollution in the atmosphere. The device, which can be worked by a person with little technical skill, will prove of great interest to licensing authorities in view of the controversies on the sulphur-emission questions that have arisen in connection with recent power station projects.

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POWER COMPANY BUILDS HOUSES FOR EMPLOYEES

In connection with its new Raritan River power station, the Eastern New Jersey Power Company, a subsidiary of the Utilities Power & Light Corporation, has built a group of fine houses for the operators, located in the village of Sayreville a half mile from the plant. A few of the houses are shown above

N. Y. Commission Urges Immediate Creation Of State Agency to Develop St. Lawrence

Declares project entirely feasible and recommends marketing power through existing utility systems

IMMEDIATE CREATION of a public power authority, to undertake development of the International Rapids section of the St. Lawrence River for production of electric power, and immediate appointment of the trustees, are recommended to Gov. Franklin D. Roosevelt and the Legislature in the full report of the St. Lawrence Power Development Commission of New York, made public Jan. 15.

The commission finds that it is entirely practicable to construct the necessary project, and to market the state's share of the power which would be developed, in such a way as to serve the best interests of the state and protect the people in their ownership of the great water-power resource.

Utilization of existing transmission and distribution systems is recommended, under a contract with existing utility companies that would assure to the consumers the advantages incident to development of this low-cost power by a public power authority.

The Commission's formal recommendations are eleven in number, as follows:

1. That a public power authority, to be known as "The Power Authority of the State of New York," be created and that the trustees of this power authority be appointed without delay.

2. That the trustees of the power authority be vested with the powers set forth in Chapter 207 of the Laws of 1930, with such additional powers as are suitable and necessary, and charged with the duty of effectuating the plan.

3. That the trustees be authorized to apply to the federal agencies for such licenses, permits, or approvals as they may be advised or decide are required in the protection of federal rights in the navigational features of the plan, with all necessary reservations of the state's proprietary rights to the water power.

4. That an agreement with the appropriate authorities in Canada be sought, covering the engineering features of the project, together with such changes in these engineering plans as may seem advisable.

5. That plans for the co-operative development of the power be worked out with the appropriate authorities in Canada.

6. That the trustees seek to negotiate with the utility companies a contract for the transmission and distribution of the power, which contract by its terms will insure: (*a*) Payment of all operating expenses of the power plant; (*b*) interest, and amortization and reserve charges sufficient to retire the bonds of the trustees in not less than 40 years and fully maintain the plant; (*c*) such charges to consumers as will insure to them the benefit of ownership, control, and operation of the plant by the power authority; (*d*) continuous control and operation of the power plant by the power authority; (*e*) full and complete disclosure to the power authority of all factors of cost in transmission and distribution of the power, so that rates to consumers may be fixed initially in the contract, and may be adjusted from time to time, on the basis of true cost data; (*f*) that rates fixed in the contract shall be contractual in their legal nature and shall not be subject to rate litigation.

7. That before final consummation of any such contract, its proposed terms shall be published, the trustees shall hold public hearings thereon, and that legislation shall provide that such proposed contract shall not be valid without the approval of the Governor.

8. That in the event of the inability of the trustees successfully to make such a contract, they shall have such powers as are necessary to make other disposition of the power.

9. That such amendatory or new legislation be enacted as will enable the state to carry out the foregoing program.

10. That the trustees be granted appropriations in sums sufficient to enable them to proceed with preparation of plans and specifications, establishment of accounting facilities for ascertaining accurate data in connection with proposed contracts, each appropriation as spent, to be treated as advances and to be included in the cost of the enterprise and to be returned to the state out of capital funds raised by the public power authority on their corporate bonds or other securities.

11. That our commission be discharged, with transfer of all records, reports, administrative and legal staffs to the trustees as soon as the trustees are organized or legally authorized to receive such transfer.

Pointing out that the great regularity of the flow of the St. Lawrence, the requirements of navigation and other elements peculiar to the river make it necessary to operate the proposed plant at a high load factor, the commission believes it advisable to encourage certain types of industry to locate at or near the site of the power house, and that within a reasonable time, if the power authority be created and authorized to solicit and make contracts, a demand from such industries can be assured sufficient to finance the project.

It acknowledges, however, that distribution of the power directly to the homes of the state would serve better the economic goal of giving the benefits to the consuming public in the most direct manner possible, but thinks it economically unwise to parallel existing transmission or distributing systems except as a possible solution in the event of failure of private utility companies to enter into a contract with the public power authority on a fair basis.

Simultaneously with the full report, Thomas F. Conway, one of the commissioners, filed a minority report, which accepts most of the findings of the other four commissioners but would arm the proposed power authority with the power to build transmission and distribution lines if it is unable to negotiate an equitable contract for marketing the power through private utilities.

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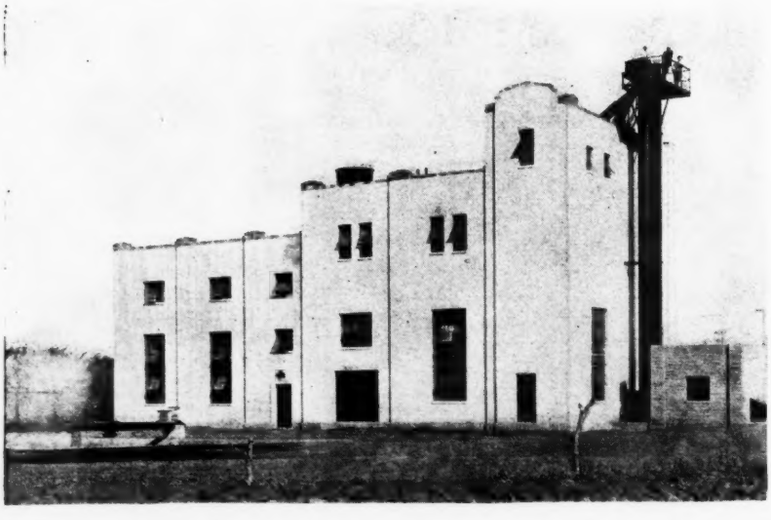
CANADA'S FIRST LIGNITE PLANT



ADJACENT to the extensive coal mining operations in the Estevan lignite field in southwestern Saskatchewan, is the new $300,000 steam power plant of the Dominion Electric Power Company, using the lignite fuel and producing power not only for the mining operations but for distribution to other industries. This 2,000-kw. plant is the first in Canada especially designed to use lignite coal, and is capable of unlimited expansion.

Canada Unfavorable To New York Plan

IT IS NOT LIKELY that the plan of New York State for development of water power in the international section of the St. Lawrence river will be acceptable to the Dominion Government, the principal reason, it is pointed out in official circles at Ottawa, being that the province of Quebec could not approve of a one-stage development. More economical development and more effective control of the water, it is held, would be possible under a two-stage development, and for that reason Canadians are adhering to it.

Another factor in the question is the attitude of the Ontario Government and the Ontario Hydro Electric Power Commission toward power development on the St. Lawrence. It is known that the commission has almost completely abandoned the idea of power develop-

ment in the international section, and has gone so far as to arrange to take a large block of power from the pending Beauharnois development. It is also tapping all the available sources of the Ottawa River, both in its own development at Chats Falls, now in course of construction, and in expressing its readiness to take its share of any power that may be developed in a larger scheme at Carillon.

N. Y. Bill Provides for Utility Plant Inspection

INSPECTION of public-utility plants and distribution equipment is provided for in a measure introduced Jan. 14 in the senate of the New York State Legislature by John J. Howard of Brooklyn. The bill was offered as an amendment to the Transportation Corporations Law and provides for thorough inspection of all construction, alteration, installation and repairs pertaining to the power plants, substations, transmission and distribution lines of electric corporations and gas and electric utilities. The inspection is to be made by inspectors appointed by the public service commission or transit commission and installations are to be judged according to "approved engineering standards."

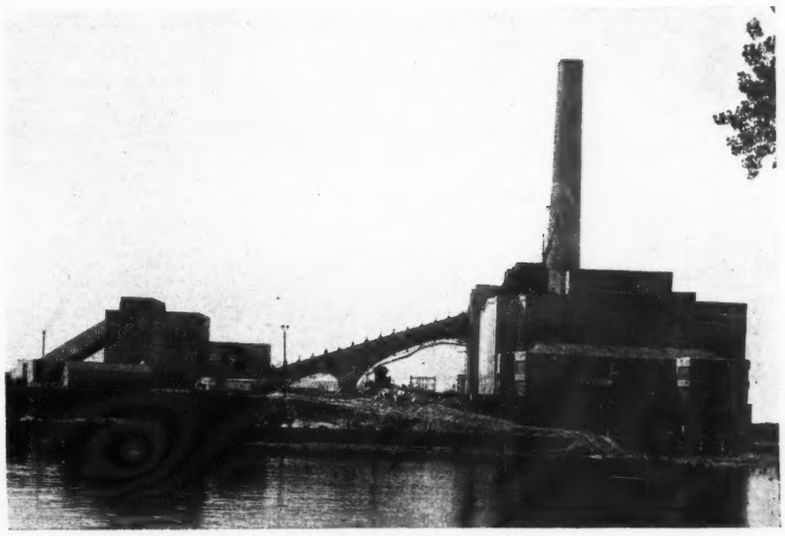
The bill was referred to the legislature's Committee on Public Service for further consideration.

New Steam Station Started in White Russia

THE FIRST 10,000-kw. turbine-generator recently began operation in the first central electric station built in White Russia, according to a report in the December issue of the *Economic Review of the Soviet Union*. Located near the Osinov peat deposits the new plant will furnish light and power to Vitebsk, Mogilev, Orsha and other cities and villages of White Russia. A second turbine of 10,000 kw. capacity will soon be completed, and the capacity of the station will be increased to 92,000 kw. in the future.

A second regional electric station for White Russia is being planned for the vicinity of Gomel, near the village of Bolotovo. This station will be built near the Kobliansk peat deposits, which are estimated to contain 21 million tons of peat, sufficient to supply the needs of an electric station of 72,000 kw. capacity for a period of 30 years. The new electric station is planned to have a capacity of 48,000 kw. in 1933, to be increased later to 72,000. The construction cost is estimated at 20 million rubles. The station will supply power to the western industrial district of White Russia, and also to the Klintzov district in the Western Region of the U.S.S.R. Construction of the first unit of 24,000 kw. is expected to be completed by Nov. 1, 1932.

Operation Begins at Michigan City Plant; Initial 68,000-Kw. Unit Turned Over



OPERATION of the new steam-electric generating station of the Northern Indiana Public Service Company, on the shore of Lake Michigan, in Michigan City, began on Jan. 9, when the unit forming the initial installation was turned over for the first time. Representing an investment of $11,600,000, the station has been equipped with a single generating unit served by three boilers. A single-cylinder Westinghouse turbine of 68,000 kw. capacity drives a main generator rated at 64,000 kw. and, on the same shaft, a house generator of 4,000 kw. The speed of the unit is 1,800 r.p.m., the main generator voltage 22,000 and the voltage of the house generator 2,300. There is no reheat of the steam. The feed-water system is of the closed type, with four stages of bleeding from the main unit.

Steam at 650 lb. pressure and a total temperature of 750 deg. F. will be supplied by three Babcock & Wilcox cross-drum boilers each having 7,917 sq.ft. of steam-making surface. Bailey water walls with 2,250 sq.ft. of surface per furnace and 14,929-sq.ft. steaming economizers supplement the boiler surface. Buffalo Forge tubular air heaters, each with 42,000 sq.ft. of surface in 2-in. tubes, recover the heat from the flue gases, while preheating combustion air from 440 to 540 deg., depending upon the rate of operation. Boiler capacity will range from a normal output of 200,000 lb. per hour to a maximum of 345,000 pound.

A furnace volume of 14,700 cu.ft. has been provided. At maximum rating the furnace heat liberation will approximate 29,900 B.t.u. per cubic foot. The furnaces are of the slag-tap type, the walls being water-cooled and the furnace bottoms air-cooled in one case and water-cooled in the other two furnaces. Pulverized coal is horizontally fired, two unit mills per boiler being provided, each with a capacity of 12½ tons per hour. Two of the boilers are equipped with Kennedy-Van Saun mills and burner equipment and the other boiler with Fuller-Lehigh pulverizers and burners. Two Cottrell electrical dust eliminators are arranged between the induced-draft fans and the stack to take the gases from the three boilers.

Coal will be crushed by Bradford breakers separately housed. Inclined belt conveyors carry the coal from the track hopper to the breaker house, and from the breaker house to the top of the boiler house, where transfer is made to a belt conveyor passing over the storage bunker. Yard storage space for a 30-day supply is provided, and more space is available when required. The coal-handling equipment has a capacity of 250 tons per hour.

THE TRACT of land upon which the new generating station is located consists of 190 acres, with approximately 5,200 ft. of shore line on Lake Michigan. Consequently, large quantities of water are available for condensing purposes and railroad facilities for the hauling of coal are ample. The new plant will be the key station in supplying electrical energy for the net work of transmission lines of the Northern Indiana Public Service Company. Energy can be carried from the new station over the Northern Indiana Public Service Company's 132,000-volt steel-tower line, which now extends 140 miles from the Illinois-Indiana state line through Aetna and Michigan City to New Carlisle and thence south to Plymouth and Monticello. Through the 132,000-volt superpower line, the new station is interconnected with the various large plants serving the Chicago Metropolitan area.

The architectural design was executed by Holabird & Root, of Chicago, and construction, which began in May, 1929, was carried out by the Herlihy Mid-Continent Company. The engineering plans for the station were drawn by Sargent & Lundy.

North American Co. to Spend $51,000,000 in 1931

FRANK L. DAME, president of the North American Company, estimates that expenditures by the company's public utility subsidiaries for additions to plants and systems during 1931 will be approximately $51,000,000.

"In 1930 construction expenditures by public utility subsidiaries of the North American Company were approximately $70,000,000," said Mr. Dame, "excluding those of the California companies which were sold to Pacific Gas & Electric Company last June. Expenditures by the same subsidiaries during 1929 amounted to $45,192,052. In order to take advantage of weather conditions unusually favorable to construction work, particularly on the large hydro-electric development on the Osage River in Missouri, certain work originally scheduled for 1931 was advanced, with the result that expenditures in 1930 exceeded earlier estimates. Acceleration of this work, as well as of the construction of the new steam electric generating plant at Ashtabula, Ohio, of additions to Lakeside plant at Milwaukee, and of new buildings at Washington, D. C., largely increased the employment of labor and gave the companies the advantage of lower prices of materials.

"Major construction programs during 1931 include the completion of the Osage hydro-electric development, the addition of a generating unit in the Benning plant at Washington, and the beginning of work on the new Port Washington plant in Wisconsin. Other expenditures will be for extensions to electric and gas distribution systems in the various territories."

Urge Permanent Agencies To Study Unemployment

A STRONG RECOMMENDATION that the emergency employment committees set up throughout the country to deal with the present situation do not disband when the emergency is over but continue to study and plan how to reduce seasonal, technological and other unemployment is contained in a 90-page report prepared by Joanna C. Colcord and published by the Russell Sage Foundation on "Community Planning in Unemployment Emergencies" made public Jan. 12. These committees, the report says, would then be prepared for the first signs of the next emergency.

The report at the same time suggests that "any comprehensive program for study and control of a community's unemployment problem should embrace at least these topics: Provision for regular employment statistics; development of an effective public employment exchange; efforts to induce individual employers and industries to regularize their own employment; long-range planning of public and private work which can be promptly undertaken in a period of unemployment; promotion of vocational training and guidance for juveniles; an industrial program for the handicapped, and legislation."

COMING CONVENTIONS

American Society of Mechanical Engineers. National Fuels Meeting in Chicago, Ill., Feb. 10-13. Semi-annual meeting in Birmingham, Ala., Apr. 20-23. Meeting at Hartford, Conn., June 1-3. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 15-18. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual Winter convention in New York City, Jan. 26-30. District meeting in Pittsburgh, Pa., March 9-13. District meeting in Rochester, N. Y., May 6-10. Annual summer convention in Asheville, N. C., June 22-26. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at the William Penn Hotel, Pittsburgh, Pa., Jan. 26-29. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting in New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

Engineering Institute of Canada. Annual meeting at the Windsor Hotel, Montreal, Que., Feb. 4-6. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National District Heating Association. Annual convention at the Hotel Statler, Boston, Mass., June 2-5. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention at the Lee House Hotel, Washington, D. C., Feb. 9-15. Secretary-treasurer, Albert L. Jones, 313 Machinists Building, Washington, D. C.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Stevens Hotel, Chicago, Ill., Aug. 4-8. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

Personals

BYRON E. WHITE in his new position as division engineer of the Niagara Hudson System will supervise the electrical engineering work of the company's central division, which includes approximately one-third of the total area served by the system. In it are 68 hydro-electric plants, three steam stations and a large transmission and distribution system that will come under Mr. White's supervision. Mr. White has been identified with water-power and public utility work since 1903.

CHARLES A. MAGRATH, who has been chairman of the Ontario Hydro Electric Power Commission since Sir Adam Beck died more than five years ago, has announced his resignation to take effect immediately. Mr. Magrath is also chairman of the International Joint Commission and from now on will devote all his time and energy to that commission's problems. No one has been appointed yet to succeed him at the head of provincial hydro affairs.

M. B. HARRIS and FRED G. STEVENOT have been appointed by Governor Young to serve on the California Railroad Commission. Mr. Harris was named for the full term of six years as successor to THOMAS S. LOUTTIT, whose term has expired. Mr. Stevenot will serve the remaining two years of the term that W. J. CARR originally had been appointed to serve. Mr. Carr resigned to accept a full-term appointment left vacant by the expiration of EZRA W. DECOTO's term.

H. O. STEPHENS, I. H. SCLATER and A. B. HENDRICKS, JR., have been appointed assistant engineers of the power transformer department of the General Electric Company, Pittsfield, Mass., of which F. F. Brand is managing engineer. Mr. Stephens will be in charge of the design of oil-immersed transformers over 7,000-kva., air-blast transformers, reactors and starting auto-transformers. Mr. Sclater will have charge of the design of oil-immersed transformers from 501 to 7,000-kva., oil-immersed current and potential transformers, radio power and SL transformers. The design of all developmental and high-voltage testing apparatus will be in charge of Mr. Hendricks.

CHARLES A. WHITNEY, a mechanical engineer of wide experience, has been appointed a member of the technical staff of the American Oil Burner Association. Mr. Whitney will spend most of his time in the field working with municipal authorities in the drafting and modernization of oil-burner ordinances.

FLOYD B. ODLUM, vice-president of the Electric Bond & Share Company and the National Power & Light Company, was elected to the vice-presidency of the American Arbitration Association at a recent meeting of its directors.

Business Notes

HAHN ENGINEERING COMPANY announces the removal of its main office from Easton, Pa., to 30 Church St., New York City. Eugene Hahn is in charge of this office.

MURRAY IRON WORKS COMPANY, Burlington, Iowa, announces the appointment of Starkweather & Broadhurst, Inc., 79 Milk St., Boston, Mass., as its sales representatives in New England.

READING IRON COMPANY, Reading, Pa., announces the appointment of F. W. Deppe, formerly district sales representative at St. Louis, Mo., as general manager of sales with offices at 230 Park Ave., New York City.

UNITED CONVEYOR CORPORATION, Chicago, Ill., announces the opening of a new office at 101 Park Ave., New York City. This office will be directed by J. J. McNulta, formerly with the Girtanner Engineering Corporation. He will be in charge of the New York and New England districts.

STERLING ELECTRIC MOTORS, INC., Los Angeles, Calif., announces that it has established and made connections with distributors or sales agencies in New York City; Boston, Mass.; Philadelphia and Pittsburgh, Pa.; Cleveland, Ohio; Denver, Colo.; Salt Lake City, Utah; Houston and El Paso, Texas, and will shortly conclude arrangements in other cities.

THE WM. POWELL COMPANY, Cincinnatio, Ohio, announces the opening of an engineering and export department office at Room 260, 50 Church St., New York City.

How's Business?

THE FIRST TWO WEEKS of the year have made a good showing. Steel production has come back. Building contracts continue well sustained for the season. Carloadings of merchandise are following their normal trend. Currency in circulation is no longer being disturbed by abnormal factors; check payments at the beginning of the year were larger than usual; and the volume of commercial loans is holding above seasonal expectations. Our index has risen fairly strongly from its bottom at around 77 per cent of normal to nearly 80 per cent. All these things indicate that deferred replacement demand by consumers, as well as better domestic investment or reinvestment demand are making for some business improvement.—*The Business Week*, Jan. 21.

WITH THE SOCIETY SECTIONS

A.S.M.E., Metropolitan Section. Meeting in Room 502, Engineering Societies Building on Jan. 20 at 8 p.m. Subjects: "Utilization of Oil Fuel for Boiler Firing," by N. E. Lewis, Babcock & Wilcox Company, and "Combined Burners for Firing Waste Fuel," by R. C. Vroom, Peabody Engineering Corporation. Joint meeting with the American Welding Society in the Westinghouse Lighting Institute Auditorium, Grand Central Palace on Jan. 22 at 8 p.m. Subject: Discussion on proposed specifications for fusion welding of unfired pressure vessels to be led by C. W. Obert, Union Carbide & Carbon Company.

A.S.M.E., Washington Section. Meeting at the Cosmos Club on Jan. 22 at 8 p.m. Subject: "Engineering and Its Relation to the Interstate Commerce Commission," by Commissioner Frank McManamy.

Plant Engineers' Club. Meeting at the University Club, Boston, Mass., on Jan. 21 at 6:30 p.m. Subject: "Purchased Power," by S. D. Fitzsimmons, Narragansett Electric Light Company.

Trade Catalogs

STEAM TURBINES—Three new publications on steam turbines have recently been published by the General Electric Company, Schenectady, N. Y. Bulletins No. GEA-1080A and GEA-1011B illustrate and describe the design and operation of turbine-generator sets for the supply of power in industrial plants and central stations. Bulletin No. GEA-1145A describes and illustrates mechanical-drive turbines designed to operate centrifugal pumps, paper machines, compressors, fans and similar machines.

FEED-WATER HEATERS—Bulletin No. 688, recently issued by the Cochrane Corporation, 17th St. and Allegheny Ave., Philadelphia, Pa., illustrates and describes open, deaerating, metering, steam-stack, vacuum, back-pressure, closed or surface, jet and storage feedwater heaters, as well as hot-process water softeners and deaerating hot-water generators.

BELTING—Kable Kord Belting, Inc., 2354 Lincoln Ave., Chicago, Ill., has just issued a new bulletin descriptive of Kable Kord flat and "V" belting.

REFRIGERATION—Grinnell liquid level control, a simple device for automatically maintaining full flooded condition in all types of refrigerating evaporators, is described and illustrated in a recent folder of the Grinnell Company, Providence, R. I.

ELECTRICAL EQUIPMENT — General Electric Company, Schenectady, N. Y., has recently issued the following new bulletins: GEA-1165 on outdoor oil circuit breakers rated at 5,000 volts and 400 to 600 amp.; GEA-925B on oil circuit breakers rated at 15,000 to 230,000 volts and 600 to 4,000 amp., and GEA-1336 on general-purpose squirrel-cage induction motors from 7.5 to 125 horsepower.

STEAM ENGINES AND GENERATORS—Bulletin No. 304, just issued by the Troy Engine & Machine Company, Troy, Pa., describes and illustrates vertical steam engines for stationary and marine service. Another new bulletin of the company, No. 602, covers direct- and alternating-current generators of the bracket and engine types. Both catalogs contain blueprints, charts, tables and much data that should prove of interest to engineers.

Fuel Prices

FUEL OIL

New York—Jan. 15, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.25c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, contract, 6c. per gal.

St. Louis—Jan. 6, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.389 per bbl., or 42 gal.; 26@28 deg., $1.48 per bbl.; 28@30 deg., $1.639 per bbl.; 30@32 deg., $1.739 per bbl.; 32@36 deg., gas oil, 4.026c.@4.276c. per gal.; 38@40 deg., distillate, 4.776c. per gal.

Pittsburgh—Jan. 7, f.o.b. local refinery, 34@36 deg., fuel oil, 3.37½c.@3.5c. per gal.; 36@40 deg., 3.37½c.@3.5c.

Philadelphia—Jan. 10, industrial use, No. 4, light, $1.31 per bbl.; No. 5, medium, $1.22; No. 6, heavy, (Bunker C) $1.10.

Cincinnati—Jan. 13, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Jan. 6, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70c. per bbl.; 26@30 deg., 95c. per bbl.; 30@32 deg., $1.00 per bbl.

Boston—Jan. 12, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@32 deg., 4.8c. per gal.

Dallas—Jan. 10, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York...	$1.75 @$2.00
Pool 10, h. gr. low-vol.	New York...	1.60 @ 1.75
Pool 11, low-vol.	New York...	1.40 @ 1.50
Smokeless, mine-run	Chicago...	1.75 @ 2.25
Smokeless, slack	Chicago...	.60 @ 1.35
Harlan, Ky., slack	Chicago...	.50 @ .90
Franklin, Ill., mine-run	Chicago...	2.15
Franklin, Ill., screen	Chicago...	1.35 @ 1.60
Ind. 5th Vein, m.-r.	Chicago...	1.50 @ 1.85
Standard Ill., mine-run	St. Louis...	1.25 @ 1.60
W. Ky., mine-run	Louisville...	1.00 @ 1.35
W. Ky., slack	Louisville...	.40 @ .60
Pittsburgh, mine-run	Pittsburgh...	1.30 @ 1.60
Smokeless, mine-run	Cincinnati...	1.75 @ 2.25
Smokeless, slack	Cincinnati...	.75 @ 1.35
Kanawha, mine-run	Cincinnati...	1.40 @ 1.60
Kanawha, nut-slack	Cincinnati...	.50 @ .75

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York...	$3.00
Barley	New York...	1.15@1.50

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ariz., Phoenix—Central Arizona Light & Power Co., 300 West Washington St., awarded contract for the construction of a sub-station to Clinton Campbell, 90 West Moreland St. Estimated cost $52,000.

Ark., Malvern—Southern Ice & Utilities Co., F. Stroup, Local Mgr., will build a 1 story, 60x90 ft. ice plant at Main and Dyer Sts. Estimated cost $40,000. Work will be done by local labor under the supervision of V. Z. Mitchell, Const. Supt.

Calif., Capitola — Soquel-Capitola Sanitary District, is having plans prepared for the construction of a sewage treatment plant including two pumping plants, screening plant, etc. Estimated cost $56,000. L. Bowman, Courthouse, Santa Cruz, is engineer.

Calif., Los Angeles—Los Angeles Times, 100 North Broadway, is having plans prepared for the construction of a 13 story office and newspaper publishing plant at First and Spring Sts. Estimated cost $3,500,000. G. B. Kaufmann, Union Bank Bldg., is architect.

Calif., Turlock—Turlock & Modesto Irrigation Districts, has made application for permit to construct two diversion dams, reservoir, power plant, conduit system, etc. Estimated cost $3,575,000. R. V. Meikle, is engineer. Work will start in about two years.

Calif., Victorville — Mojave Irrigation Dist., has made application for permit to construct a diversion dam, storage dam, canal system, etc. Estimated cost $1,500,000. J. B. Lippincott, Petroleum Securities Bldg., Los Angeles, is engineer. Project will mature in about ten months.

Ga., Cordele — Sawyer Coal & Ice Co., c/o E. J. Sawyer, 6th St., Macon, is having plans prepared for the construction of an ice and cold storage plant here. Estimated cost $75,000. C. T. Baker, Walton Bldg., Atlanta, is architect.

Ill., Aurora—Copley Hospital, G. A. Anderson, Pres., will receive bids about Mar. 1 for a 6 story addition to hospital including power plant, etc., at Lincoln and Weston Sts. Estimated cost $400,000. Schmidt, Garden & Ericksen, 104 South Michigan Ave., Chicago, Ill., are architects.

Ill., Vandalia—State of Illinois, will receive new bids for the construction of a sewage treatment plant including pump house, mains, etc. at Illinois State Farm. Division of Architecture and Engineering, Capitol Bldg., Springfield, is engineer.

Kan., Kansas City—Bd. of Public Utilities, C. Lowder, Secy., will receive bids until Jan. 28 for the construction of a 94x130 ft. power plant. Burns & McDonnell Engineering Co., 407 Interstate Bldg., Kansas City, Mo., are engineers.

Kan., Parsons—City will soon receive new bids for sewage treatment work including booster pumping station, etc. H. E. Glaze, City Hall, is engineer.

Mass., Boston—Bureau of Yards & Docks, Navy Dept., plans improvement of heating system at Boston Navy Yard. Estimated cost $100,000. Private plans.

Mass., Boston—Owner c/o Blackall, Clapp, Whittemore & Clark, 31 West St., Archts., is receiving bids for a 22 story stores and office building at Berkley St. and St. James Ave. Estimated cost $4,000,000.

Minn., St. Paul—City plans the construction of a power plant to furnish power and light to city buildings at Hill and Marlet Sts. Estimated cost $250,000.

Miss., Greenville—Greenville Ice & Coal Co., I. B. Isenberg, Mgr., awarded contract for remodeling ice plant to York Ice Machinery Corp., 609 Tchoupitoulas St., New Orleans. Estimated cost $45,000.

Neb., Fallon—Bureau of Reclamation, Denver, plans the construction of a new power plant at Lahontan dam, Newlands Reclamation Project, also repairs to present plant. Estimated cost $200,000. R. F. Walter, Denver, is chief engineer.

N. H., Littleton — Littleton Hospital, M. M. Eaton, Pres., Bd. of Trustees, will receive bids in February for a 3 story hospital and power house. Estimated cost $150,000. Rich, Mathesius & Koyl, 320 5th Ave., New York, are architects.

N. J., Jersey City—Bd. of Commissioners, City Hall, will soon award contract for the construction of a 14 story medical staff house including steam heating and ventilation systems, boilers, elevators, etc., at Baldwin and Montgomery Sts. Estimated cost $850,000. J. T. Rowland, Jr., 30 Journal Sq., is architect.

N. Y., Brooklyn—Dept. of Mental Hygiene, State Office Bldg., Albany, received lowest bid for electric service connections and additional power plant equipment at Brooklyn State Hospital, Creedmore Division, from T. F. Jackson, Inc., 25 West 43rd St., New York, $97,850.

N. Y., New York—New York Edison Co., 4 Irving Pl., awarded contract for street lighting improvements and equipment, also buildings and equipment at East River generating station $5,529,100. Work will be done by separate contracts and day labor.

N. Y., New York—United Electric Light & Power Co., 4 Irving Pl., plans to expend $6,329,000 for generating plants, equipment and miscellaneous work, including equipment for Hell Gate's station steam generating plant. Work will be done by general and separate contracts and day labor.

Okla., Hominy — City will receive bids in February for the construction of a power plant. Estimated cost including equipment $150,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, are engineers.

Ore., Eugene—Eugene Water Board, awarded contract for the construction of major portion of new steam plant power house to Hargreaves & Lindsay. Estimated cost $24,312.

Tex., Marble Falls—Emery, Peck & Rockwood Development Co., will receive bids until Jan. 29 for the construction of a power house on the Colorado River, also dam 9,000 ft. long and 137 ft. above river bed near here. Estimated cost $1,400,000 and $2,000,000 respectively.

Tex., Sugarland—State Bd. of Control, will receive bids until Jan. 23 for the construction of a group of buildings including dormitory, administration building, power plant, refrigeration plant, etc., for Texas Prison system at Central State Farm Unit near here.

Tex., Tyler—M. Burnett, Greenville, will soon start work on the construction of a 20 ton ice plant here.

Va., Bremo Bluff — Virginia Public Service Co., subsidiary of National Electric Power Co., 57 William St., New York, plans the construction of a steam power plant here. Estimated cost exceeds $1,000,000.

Wash., Seattle—City will soon receive bids for sewage system including two pumping stations, etc. Estimated cost $189,860.

Man., Churchill—Dept. of Railways & Canals, Ottawa, Ont., will receive bids until Jan. 27, for a group of buildings to house power plant. Estimated cost $250,000.

Ontario — Hydro-Electric Power Commission of Ontario, 190 University Ave., Toronto, plans the construction during 1931 of 1850 miles of rural transmission line. Estimated cost $4,380,000. T. Hogg, 190 University Ave., Toronto, is chief engineer. Work will be done by day labor.

Ont., Toronto—Four Hundred Fifty Bay Street Ltd., c/o Sparling, Martin & Forkes, Trust & Guarantee Bldg., Archts., is having plans prepared for the construction of an 18 story office building including steam heating system, etc. at Bay and Albert Sts. Estimated cost $800,000.

Ont., Toronto—Royal Ontario Museum, Bloor St. W., will soon award contract for the construction of a 3 story addition to museum building, including steam heating system, etc. Estimated cost $1,500,000. Chapman & Oxley, Sterling Tower, are architects.

Equipment Wanted

Boiler—DeKalb, Ill.—Illinois Power & Light Co., A. D. Mackie, Gen. Mgr., Springfield, plans the installation of a new boiler in power plant here. Estimated cost $90,000.

Electrical Equipment — Seattle, Wash. — Bd. of Public Works, taking bids for the installation of electrical equipment including automatic switchboard equipment and subway transformers for 200 to 300 kva. for Lake Union steam auxiliary and North End substation. Estimated cost $100,000.

Engine—Pawnee, Okla.—City plans the installation of a Diesel engine in municipal waterplant. Estimated cost $25,000.

Engine—Pawhuska, Okla.—City plans the installation of an additional 600 hp. Diesel engine for municipal electric light plant. Estimated cost $50,000.

Power Equipment—Cushing, Okla.—City will receive bids about Feb. 10, for power equipment in connection with proposed municipal light plant. Estimated cost $300,000.

Pumping Equipment—Monterey, Minn.—City, E. Peterson, Clk., will receive bids until Jan. 27 for pumping equipment, etc., for proposed waterworks improvements. Estimated cost $25,000.

Pumping Unit—Fort Frances, Ont.—Town plans to purchase pumping unit, etc., in connection with removal of waterworks pump house from Rainy River to Rainy Lake. Estimated cost $105,300.

Pumps—Mannsville, N. Y.—Village Board, will receive bids until Jan. 21 for one gas and one electrically driven centrifugal pumps, etc., for proposed waterworks. Estimated cost $30,000.

Pumps, Meters, etc. — Ottawa, Ont. — City Council plans to purchase new pumps and water meters for Queen Street pumping station. $56,000.

Industrial Projects

Ill., Chicago—Midland Specialties Co., 536 West 25th St., manufacturers of oil measures and funnels, awarded contract for the construction of a 1 story factory on South Richmond St. to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $50,000.

Ill., Pekin—Corn Products Refining Co., 17 Battery Pl., New York, N. Y., plans the construction of a corn sugar refinery to include power house, machine shop, etc., here, also additions to refinery at Kansas City, Mo. Estimated cost approximately $2,000,000 and $500,000 respectively.

Mass., South Lee—Dwight D. Hopkins Lumber Co., plans to rebuild woodworking plant recently destroyed by fire. Architect not selected. New woodworking machinery will be required.

N. J., Jersey City — B. Singer, 921 Bergen Ave., Archt., will receive bids about Feb. 15 for the construction of a 2 story, 45 x 140 ft. factory on Crawford St. for Jersey City Ladder Co., Inc., 677 Montgomery St. Estimated cost $50,000.

N. J., Newark—Weldon Roberts Rubber Co., 180 Olive St., is having preliminary plans prepared for the construction of a 2 story factory at 361-65 6th Ave. Estimated cost $40,000. M. N. Shoemaker, 10 Bleecker St., is architect.

O., Cleveland—Reserve Lithographing & Printing Co., P. N. Calvert, Pres., Caxton Bldg., will soon award contract for the construction of a 3 story, 100x132 ft. lithograph plant at East 9th St. and Wigman Pl. Estimated cost $150,000. W. R. Powell, Rose Bldg., is architect.

O., Dayton — Dayton Greenhouse Mfg. Co., 939 South Perry St. is having plans prepared for the construction of a 1 and 2 story, 60 x 400 and 30 x 60 ft. factory at Miami Chapel Rd. Estimated cost $75,000. Geyer & Neuffer, Arcade, are architects.

Pa., Sharpsville — Sharpsville Boiler Works, will soon award contract for an assembly building for gasoline pumps. Estimated cost $40,000.

Tenn., Chattanooga—Davenport Hosiery Mill, 906 Georgia Ave., had plans prepared for the construction of a hosiery mill. Estimated cost $150,000. Roberts & Co., Bona Allen Bldg., Atlanta, Ga., are architects.

Tenn., Kingsport—Tennessee Eastman Corp., will soon award contract for addition to cellulose plant. Estimated cost $75,000. Private plans.

Tex., Fort Worth—Corp., c/o H. Scullin of Scullin Steel Co., 6700 Manchester St., St. Louis, Mo., is having preliminary plans prepared for the construction of fabricated steel manufacturing plant here. Estimated cost $3,000,000. McCrossin & Knapp, 82 Beaver St., New York, N. Y., are engineers.

Wash., Seattle — A. R. Turner Co., 2325 Iowa Ave., plans the construction of a 1 story, 80 x 200 ft. factory for the manufacture of roofing paper, mineraled surfacing roofing and building and tarred paper. Estimated cost $65,000.

Wis., Barksdale—E. I. DuPont de Nemours & Co., duPont Bldg., Wilmington, Del., will build a nitric acid plant and other manufacturing and chemical buildings here. Estimated cost to exceed $40,000. DuPont Engineering Co., DuPont Bldg., Wilmington, are engineers. Work will be done by day labor and separate contracts.

Ont., York—Paton & Baldwins, Halifax, Yorkshire, England, and 888 Dupon St., Toronto, acquired a site and plans the construction of a woolen mill here. Estimated cost $150,000. H. W. Cowan, 129 Adelaide St. W., Toronto, are engineers.